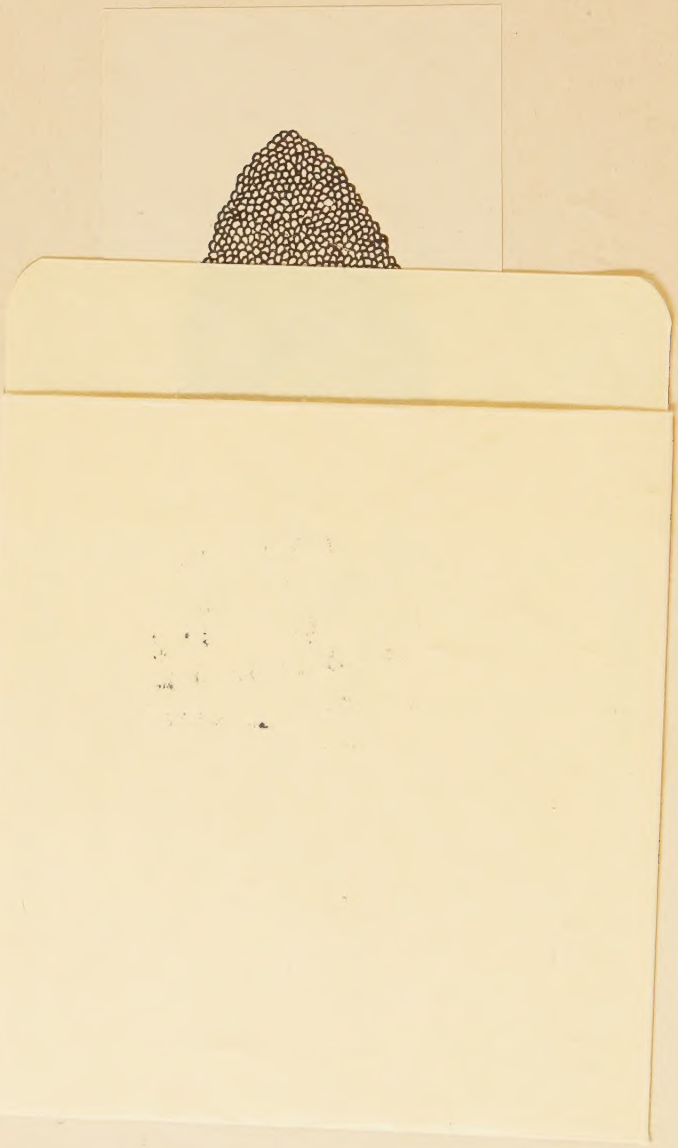

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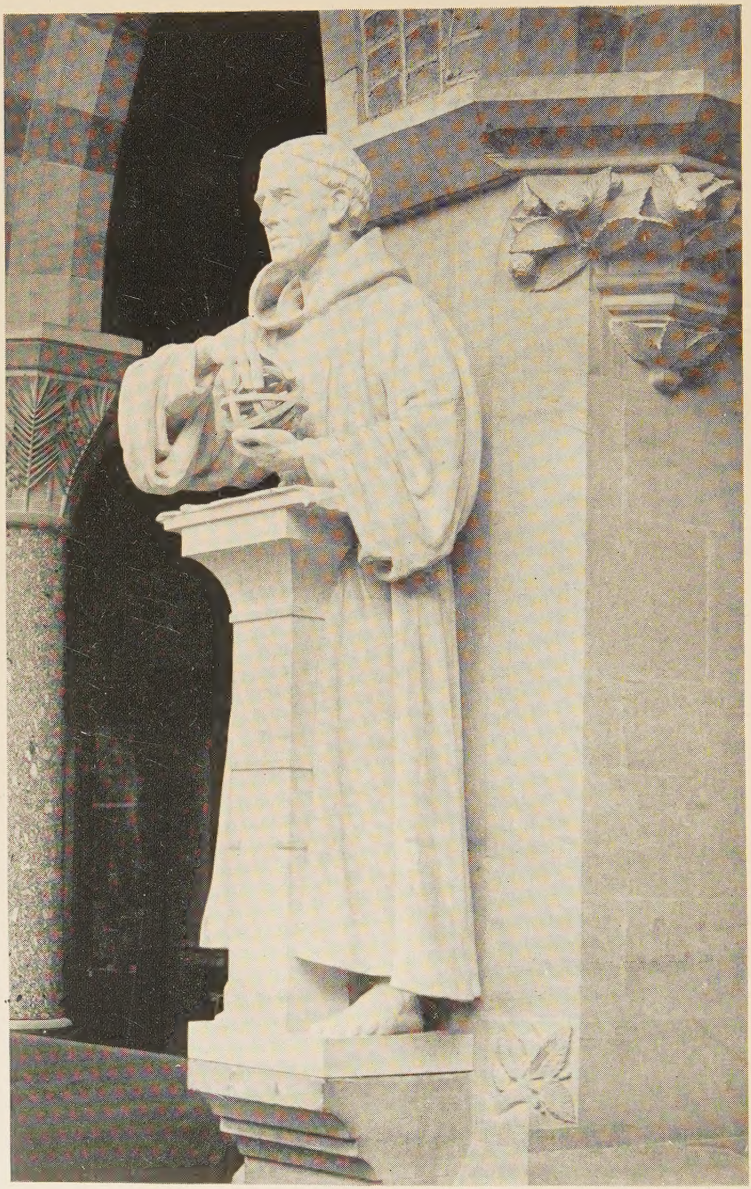

ROGER BACON

The Hope-Pinker Statue in the Oxford University Museum

THE

OPUS MAJUS

OF

ROGER BACON

WITHDRAWN

A Translation by

ROBERT BELLE BURKE

PROFESSOR OF LATIN AND DEAN OF THE COLLEGE
UNIVERSITY OF PENNSYLVANIA

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VOLUME I

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FOREWORD

This translation of the Opus Majus *is based on the corrected text of Bridges' edition, London, 1900. Messrs. Williams and Norgate, publishers of Bridges' edition, have kindly granted permission to reproduce the drawings which were copied by Dr. Bridges from the original manuscripts of the* Opus Majus.

I have tried to keep in mind the needs of the reader who desires to follow the Latin text with the aid of a translation, and for this reason I have not attempted as a rule to paraphrase or break up Bacon's sentences.

I gladly take this opportunity to express my deep obligation for aid generously given me in this work by my colleagues, the late Professor W. R. Newbold, Professor Isaac Husik, Professor R. G. Kent, Professor G. H. Hallett, and Professor E. A. Singer, Jr.

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The Hope-Pinker Statue. Courtesy of the Oxford University Museum

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The Berlinghieri Paraphrase of Ptolemy's *Geographia*. Courtesy of the Library of Congress

INTRODUCTION

COMPARATIVELY little is known of the life of Roger Bacon. Even the exact year and place of his birth are in doubt. From a statement made by Bacon in the *Opus Tertium* we infer that he was born between 1210 and 1215. From the same source we learn that his family was one of considerable wealth, but had been reduced to utter poverty by its adherence to Henry in his dispute with his barons. He received his collegiate training at Oxford and, as he states in the *Opus Tertium,* devoted more than twenty years to the study of languages and science. "I sought," he writes, "the friendship of all wise men among the Latins; and I caused young men to be trained in languages, in geometrical figures, in numbers, in the construction of tables, in the use of instruments, and in many other necessary things. . . . During this time I spent more than two thousand pounds in those things and in the purchase of books and instruments."

About 1240 Bacon left Oxford and went to the University of Paris, where he received the degree of doctor of theology. It was during his sojourn in Paris that he entered the Franciscan Order about 1247. He subsequently returned to England, but incurring the suspicion of his superiors in the Franciscan Order he was exiled to Paris and placed under restraint in the Paris house.

Guy Fulcodi, who practiced law in Paris for a number of years with great distinction and also served as private secretary to Louis IX, entered the Church after the death of his wife and was elevated to the Papacy in 1265 as Clement IV. While in Paris he had every opportunity to hear of Bacon and his work, and was evidently so favorably impressed that after his elevation to the Papacy he wrote a letter in 1266 to Bacon directing him to transmit copies of all his writings without delay.

As a matter of fact up to this time Bacon had written but little with the exception of a formal treatise *De Multiplicatione Specierum.* Bacon began work at once and composed rapidly the *Opus Majus, Opus Minus,* and *Opus Tertium* and dispatched them together with a copy of the *De Multiplicatione Specierum* to the Pope by the hand of a poor lad named John,

whom he had been training for several years. We have no means of determining whether the Pope, who died a few months later, ever received Bacon's works.

In 1271 Bacon published his *Compendium Studii Philosophiae,* in which he vigorously assailed the vice and corruption of his day and in particular the pedantry and false conceit of knowledge rife in the schools. Because of the antagonism thus aroused and the daring novelty of much of his teaching he was finally brought to trial in 1278, condemned, and thrown into prison, where he remained for fourteen years. He was released in 1292, but died shortly afterwards and was buried in the Franciscan Church at Oxford.

The *Opus Majus,* on which Bacon's fame chiefly rests, was written with the purpose of correlating the learning of the thirteenth century and making it available to the Church in its work of elevating and saving mankind. Whewell, in his *Philosophy of the Inductive Sciences,* says: "The *Opus Majus* is a work equally wonderful with regard to its general scheme and to the special treatises with which the outlines of the plan are filled up." Dr. Bridges, in his admirable introduction to the *Opus Majus,* remarks: "The *Opus Majus* remains the one work in which the central thought of Bacon is dominant from first to last: the unity of science and its subordination to the highest ethical purpose conceivable by man."

After several years of study of the *Opus Majus* the translator ventured in a recent article to express his opinion of Bacon's great work in the following words: "In its unity of purpose, in its encyclopaedic range of subjects, in its clarity of statement, in its orderly arrangement of material, in its prophetic scientific vision, in its profound moral earnestness the *Opus Majus* must ever remain one of the few truly great works of human genius." It is certainly within the limits of truth to say that no other great scientific work has ever been inspired by so lofty a purpose as that which ennobled the *Opus Majus* of Roger Bacon.

The *Opus Majus* is divided into seven parts. Part I considers the causes of human error and classifies them as four—Undue regard to Authority, Habit, Popular Prejudice, and False Conceit of Knowledge. Part II shows the close relationship between Philosophy and Theology. Part III emphasizes the importance

and utility of the Study of Foreign Languages. Part IV urges the necessity of greater mathematical knowledge, since this science is the key to all other sciences. Its great utility is shown in Astronomy, Optics, Theology, Chronology, Astrology, and the Correction of the Calendar. This section closes with a Treatise on Geography. Part V treats of Optics. It contains a thorough discussion of the General Principles of Vision, Direct Vision, Reflection, and Refraction. Part VI is a plea for Experimental Science and an exposition of the correct method of scientific approach in solving natural problems. Part VII treats of Moral Philosophy, the final and supreme science. It discusses man's relation and duty to God, to his fellows, and to himself, makes the first comparative Study of Religions, and proves the Superiority of the Christian Faith.

Manuscript copies of Bacon's works in more or less mutilated condition are preserved in different parts of Europe, notably in the Mazarin Library in Paris, in the Vatican Library, in the British Museum, in the Bodleian and University College Libraries at Oxford, and at the University of Dublin. The first printed edition of the *Opus Majus* appeared in 1733, edited by Jebb. Bridges' edition with an Introduction was published at the Clarendon Press in 1897. A supplementary volume containing many corrections to the text of the edition of 1897 was published by Dr. Bridges in 1900. The most important contributions in modern times on Bacon and his work are Dr. Bridges' Introduction to the *Opus Majus* and his Analysis in English of its contents, and the masterly treatise of E. Charles, *Roger Bacon, sa Vie, ses Ouvrages, ses Doctrines d'après des textes inédits,* 1861.

Great interest throughout the world was excited some years ago by the announcement of the late Professor W. R. Newbold of the University of Pennsylvania that he had succeeded in deciphering the code in which an unpublished manuscript of Bacon, known as the Voynich Manuscript, is written. At the time of his death Professor Newbold was completing a volume descriptive of his work on the cipher and giving his conclusions. Scholars interested in the work of Bacon will be pleased to learn that this volume will soon appear, edited by Professor Roland G. Kent of the University of Pennsylvania and published by the University of Pennsylvania Press.

THE OPUS MAJUS OF ROGER BACON

EMENDATIONS

Page 7, line 20 *for* he says *read* we read
Page 15, line 21 *for* Priscan *read* Priscianus
Page 20, line 34 *for* well the *read* well as the
Page 41, line 22 *for* Lactanius *read* Lactantius
Page 45, line 34 *for* intellect *read* An Intelligence
Page 77, line 20 *for* Theodotian *read* Theodotion
Page 79 and page 80 *passim for* active *read* practical
Page 91, line 18 *for* this a *read* this is a
Page 105, line 35 *for* then denotes *read* then it denotes
Page 117, line 33 *for* them. *read* them,
Page 119, line 8 *for* active *read* practical
Page 586, line 11 *for* that relies, etc. *read* that attempts to perform the actions of men
Page 623, line 20 *for* seasoned *read* adulterated
Page 635, line 17 *for* action, etc. *read* the practice, that is, the doing of good or evil
Page 635 *passim* except in line 12 *for* active *read* practical
Page 795 *passim for* active *read* practical

PART ONE

Chapter I

A THOROUGH consideration of knowledge consists of two things, perception of what is necessary to obtain it and then of the method of applying it to all matters that they may be directed by its means in the proper way. For by the light of knowledge the Church of God is governed, the commonwealth of the faithful is regulated, the conversion of unbelievers is secured, and those who persist in their malice can be held in check by the excellence of knowledge, so that they may be driven off from the borders of the Church in a better way than by the shedding of Christian blood. Now all matters requiring the guidance of knowledge are reduced to these four heads and no more. Therefore, I shall now try to present to your Holiness the subject of the attainment of this knowledge, not only relatively but absolutely, according to the tenor of my former letter, as best I can at the present time, in the form of a plea that will win your support until my fuller and more definite statement is completed. Since, moreover, the subjects in question are weighty and unusual, they stand in need of the grace and favor accorded to human frailty. For according to the Philosopher in the seventh book of the Metaphysics, those things which in themselves are susceptible of the most perfect cognition are for us objects of but imperfect apprehension. For truth veiled lies hidden in the deep and is placed in the abyss, as Seneca says in the seventh book of his De Beneficiis, and in the fourth of the Quaestiones Naturales; and Marcus Tullius says in the Hortensius that our entire intellect is obstructed by many difficulties, since it is related to those things which are most manifest in their own nature as is the eye of the night-owl or of the bat to the light of the sun, as the Philosopher declares in the second book of the Metaphysics; and as one deaf from his birth is related to the delight of harmony, as Avicenna says in the ninth book of the Metaphysics, wherefore in the investigation of truth the feebleness of our own intellect suffices for us, that we may to the best of our ability put extraneous causes

and occasions of error at a farther remove from our weak power of sense perception.

Now there are four chief obstacles in grasping truth, which hinder every man, however learned, and scarcely allow any one to win a clear title to learning, namely, submission to faulty and unworthy authority, influence of custom, popular prejudice, and concealment of our own ignorance accompanied by an ostentatious display of our knowledge. Every man is entangled in these difficulties, every rank is beset. For people without distinction draw the same conclusion from three arguments, than which none could be worse, namely, for this the authority of our predecessors is adduced, this is the custom, this is the common belief; hence correct. But an opposite conclusion and a far better one should be drawn from the premises, as I shall abundantly show by authority, experience, and reason. Should, however, these three errors be refuted by the convincing force of reason, the fourth is always ready and on every one's lips for the excuse of his own ignorance, and although he has no knowledge worthy of the name, he may yet shamelessly magnify it, so that at least to the wretched satisfaction of his own folly he suppresses and evades the truth. Moreover, from these deadly banes come all the evils of the human race; for the most useful, the greatest, and most beautiful lessons of knowledge, as well as the secrets of all science and art, are unknown. But, still worse, men blinded in the fog of these four errors do not perceive their own ignorance, but with every precaution cloak and defend it so as not to find a remedy; and worst of all, although they are in the densest shadows of error, they think that they are in the full light of truth. For these reasons they reckon that truths most firmly established are at the extreme limits of falsehood, that our greatest blessings are of no moment, and our chief interests possess neither weight nor value. On the contrary, they proclaim what is most false, praise what is worst, extol what is most vile, blind to every gleam of wisdom and scorning what they can obtain with great ease. In the excess of their folly they expend their utmost efforts, consume much time, pour out large expenditures on matters of little or no use and of no merit in the judgment of a wise man. Hence it is necessary that the violence and banefulness of these four causes of all evils should be recognized in the beginning and re-

buked and banished far from the consideration of science. For where these three bear sway, no reason influences, no right decides, no law binds, religion has no place, nature's mandate fails, the complexion of things is changed, their order is confounded, vice prevails, virtue is extinguished, falsehood reigns, truth is hissed off the scene. Therefore nothing is more necessary of consideration than the positive condemnation of those four errors through the chosen arguments of wise men which shall prove irrefutable. Inasmuch as the wise unite the first three together and condemn them, and since the fourth, owing to its exceptional folly, needs special treatment, I shall first attempt to show the banefulness of the three. But although authority be one of those, I am in no way speaking of that solid and sure authority, which either by God's judgment has been bestowed upon his Church, or which springs from the merit and dignity of an individual among the Saints, the perfect philosophers, and other men of science, who up to the limit of human utility are expert in the pursuit of science; but I am speaking of that authority, which without divine consent many in this world have unlawfully seized, not from the merit of their wisdom but from their presumption and desire of fame—an authority which the ignorant throng concedes to many to its own destruction by the just judgment of God. For according to Scripture "owing to the sins of the people frequently the hypocrite rules"; for I am speaking of the sophistical authorities of the irrational multitude, men who are authorities in an equivocal sense, even as the eye carved in stone or painted on canvas has the name but not the quality of an eye.

Chapter II

These three errors sacred Scripture reproves, sainted doctors condemn, canon law forbids, philosophy rebukes; but for reasons previously touched upon in regard to adducing philosophical principles, and since the judgments of philosophers in regard to these three are less widely known, I shall in the first instance adduce those judgments. Seneca indeed condemns all these three banes at once in the book of his Second Epistles near the end in a single statement. He says, "Among the reasons

for our evils is the fact that we live according to examples, and are not regulated by reason but influenced by custom. That which if done by few we should not care to imitate, when many begin to do it, we do it also, influenced by numbers more than by higher motives, and an error when it has become general takes for us the place of truth." The Philosopher, in fact, through the whole course of his philosophy attacks unworthy authority and asserts in the second book of the Metaphysics that the chief sources of human error are custom and the influence of the masses. Seneca again in his book on the Happy Life says, "No man errs for himself alone, but he is the cause and author of another's error, and error transmitted from one to another tosses and drives us headlong, and we come to grief by the examples of other men." In his second book on Anger he says because of the evil of custom, "With difficulty are those vices lopped off which have grown up with us." Moreover in his book on Happiness of Life, in opposition to the common opinion he says, "Nothing involves us in greater evils than the fact that we regulate our lives by mere report, reckoning best that which has been so accepted by general consent, and we do not live according to reason but in accordance with our desire to copy others. Hence comes that heaping together of man tumbling over man. For in a great massacre of men, when the mob crowds upon itself, no one falls in such a way as not to drag his neighbor after him, and the first cause those that follow them to stumble into destruction. You may see this happening in every life." He likewise says in the same book, "The mob pits itself against reason in defence of its own bane"; and he adds, "Human affairs are not so well ordered that better counsels please the majority of us," and he continues, "A crowd is the worst of arguments." Marcus Tullius, also, in the third book of the Tusculan Disputations says, "When we have been handed over to school masters, we are not only imbued with divers errors, but truth yields to vanity and firmly established nature herself gives way to mere opinion." Also he says in the Lucullus, "Some complying with a friend or captivated by the mere discourse of some one to whom they have listened, form judgments about matters unknown to them, and driven as it were by stress of weather to some branch of study, no matter what, they cling to it as though to a rock. Many have chosen to remain in error and to defend

the opinion to which they are sentimentally attached, rather than without obstinate prepossession to scrutinize that which they assert with the utmost positiveness." Because of the viciousness of custom he asks in the first book on the Divine Nature, "Is not the investigator of nature ashamed to seek testimony to the truth from minds steeped in custom?" Moreover in opposition to the notions of the mob he says in the introduction to the second book of Disputations, "Philosophy is content with few judges, shunning purposely the multitude to which it is an object of suspicion and hatred." In the same second book he says, "I think all things are the more praiseworthy if they occur without the knowledge of the public." But others attack these three errors separately. For in Adalardus' book on Questions about Nature the following query is put about weak authority: "What else is authority of this kind than a halter? Just as brute beasts are led with any kind of halter whithersoever one wishes, and do not perceive whither they are being led nor why; so not a few, captive and bound by beastlike credulity, mere authority leads off into danger." Moreover, in the book on the Eternity of the World he says, "The man who chooses one side of a question because of his love of custom cannot rightly discern the correct opinion." Averroës also at the end of his second book on the Physics says, "Custom is the chief cause hindering us from grasping many clear truths. Just as certain actions though harmful will become easy to the man accustomed to them, and for this reason he comes to believe that they are useful; similarly when one has become accustomed to believe false statements from childhood, the habit so formed will cause him to deny the truth, even as some men have become so used to eating poison that it has become to them a food." Averroës likewise maintains in his commentary on the second book of the Metaphysics that the contraries of the principles, provided they be of general repute, are more gladly received by the multitude and by those who follow the testimony of the majority, than are the fundamental principles themselves." And also Jerome in the introduction to the fifth book of his commentary on Jeremiah asserts that truth is contented with few supporters and is not dismayed by a host of foes. John Chrysostom in his commentary on Matthew says that those who have armed them-

selves with the multitude, have confessed themselves to be unprotected by truth.

Chapter III

The experience of the individual decides any matter which has been proved by authorities with still greater certainty.

For we experience in ourselves and in others that these three, involving as they often do evils, are still more frequently connected with the false. But if at any time they are united with the good and the true, the latter are almost always imperfect, and attain only a low rank in science. As a rule the daughter follows the example of her mother, the son the father's, the slave the master's, the porter the king's, the subordinate the superior's, the pupil the master's. Because it is a familiar trait of the sons of Adam to claim for themselves authority and to disseminate in the light their own standards. For all men, according to Aristotle in the fourth book of his Ethics, love their own works, as for example parents their children, poets their measures, and so on through the list. In fact, many have indulged in too great freedom in their writings, and have not hesitated even to insinuate to vicious and brutelike men the thought, Why do you not fill up your pages? Why do you not write even on the back of the sheet? These men are like a lame and blind shepherd with many sheep, which wandering through the by-paths of untruth they have neither the power nor the knowledge to recall to the more healthful pastures of science, and they are like birds desiring to fly without wings, assuming the office of a master before they have acquired the status of a good pupil. These men of necessity fall into so many errors, because lazy people, by comparing themselves with one another, come to reckon themselves lucky; just as when many competitors run a race, he whom despair of winning does not suffer to enter, no matter how precious the prize of victory appears in his eyes, nevertheless reckons himself lucky in comparison with the contestant who as he runs falls into an unseen pitfall. And thus we see with our very eyes that for one example of truth as well in science as in life there are more than a thousand examples of falsehood. For the world is full of examples

of this kind, and one example of true perfection easily discovers ten thousand imperfect ones. In numbers nature has formed for us her own illustration of perfection and imperfection. A number is called perfect, the sum of whose aliquot parts exactly equals the number, but there is only one below ten, namely six; and one between ten and one hundred, namely 28; and one between one hundred and a thousand, namely 496; and one between a thousand and ten thousand, namely 8128; and so on. Would that this were the case among men, and it would be sufficient for mankind. But never has this been a fact either in life or science, nor will it be until the final destruction of sin, since not only is there a scarcity of those who are perfect in every virtue and science, but of those who have reached perfection in a single virtue or science. The first are and will be and have always been very few. For they are in fact perfect; since out of ten thousand men one is not found thus perfect either in his way of life or in the matter of wisdom. Would that of the second class of perfection there might be one in ten, and so on with the other classes, so that the perfection of numbers might be maintained in the case of human beings. But it is not so; nay, it is found to be quite the contrary. Similarly concerning custom we prove by experience in our own acts what has just been said with reference to types of individuals. Let any man you please consider his own life from his infancy, and he will find that in the majority of his acts it has been easier for him to reduce to habit what is false and evil. For, in what is good and true, repetition, such is our human frailty, is the mother of satiety, and the wretched man delights himself in the variety of things useful, according to the judgment of the authorities which I mentioned in the beginning; but he is, on the contrary, delighting in things evil and false and harmful to himself and to others. For in most of our actions, unless special grace and divine privilege intervene in the case of some perfect individuals, human corruption diligently persists in what is opposed to truth and salvation; the individual neither feels persistence in sin to be irksome, nor is prone to find vain things contemptible. But if a man from his youth should devote himself to truth in life and science, he in most of his activities persists in his imperfection and takes pleasure therein: perfection, in fact, more frequently saddens him, for it delights very few

of us, and especially is this true in the rich fulness of the virtues and sciences; and for this reason youth seldom guards against error, and old age with the greatest difficulty climbs to perfection in anything. Of the mob the same statement holds good. For the great mass of mankind has always erred in regard to God's truth, and only the small body of Christians has received it; moreover, we know that most Christians are imperfect, a fact shown by the small number of saints. The same is true concerning philosophical doctrine; for the mass of mankind has always lacked the wisdom of philosophy. This is shown by the small number of philosophers. In fact, the rank and file of those devoting themselves to philosophy have always remained imperfect. For of famous philosophers Aristotle alone with his followers is stamped with the approval of all wise men, since he organized the branches of philosophy as far as was possible in his age; but nevertheless he did not reach the limit of wisdom, as will be clearly shown below.

Chapter IV

However little authority may be depended upon, it possesses, nevertheless, a name of honor, and habit is more strongly inducive to error than authority; but popular prejudice is more forceful than either of them. For authority merely entices, habit binds, popular opinion makes men obstinate and confirms them in their obstinacy. Habit is a second nature, as the Philosopher says in his book on Memory and Recollection, and in his book of Problems; and for this reason habit brings a greater force to bear than authority. Hence the Philosopher in the tenth book of his Ethics agrees with the sentiment of Jeremiah in regard to the Ethiopian's skin, saying that it is impossible or difficult for him who through habit has grown hardened in evil, to change for the better. Sallust also in his Jugurtha expresses the thought of Solomon when he says, "They spend their old age where they passed their youth." Popular sentiment in fact is far worse than other sentiments. For as Seneca says in the third book of his Declamations, "The multitude once stirred cannot preserve a due moderation." On this point John Chrysostom says in his commentary on Matthew, "They assembled to con-

quer by numbers him whom they were unable to overcome by their reason." We must consider carefully that the unenlightened throng is not only more energetic in its invitation to evil than the other two sources of error, but is more foolish and further removed from the pale of wisdom. For an example of perfection is drawn upon by an individual to form habit, but it suffices the throng not to sin. For in no rank of the Church is it required that the body at large should possess the perfection of the Church. For even among the religious a small number is fixed at the center of perfection, and the rest wander about on the circumference. Such is the case, as we clearly see, both in the ranks of the secular clergy and of the laity. For as with Moses so with Christ the common throng does not ascend the mountain. Nor in the transfiguration of Christ was the whole body of disciples taken with him, but only the three specially chosen; and when the multitude followed for two years Christ the teacher of perfection as he preached, it afterwards dismissed him, and finally cried out, Crucify him. For the common throng cannot continue anything that is perfect; would that it were avoiding error in life and in pursuit. We see that such is the case among the professors of philosophy as well as in the truth of our faith. For the wise have always been divided from the multitude, and they have veiled the secrets of wisdom not only from the world at large but also from the rank and file of those devoting themselves to philosophy. For this reason wise men of Greece meeting in the watches of the night devoted their leisure, apart from the multitude, to scientific collaboration, of which A. Gellius writes in his book of Attic Nights, the title indicating efforts of this kind made by learned men of Attica, that is Athenians, during the watches of the night in order to avoid the multitude. In this book he says that it is foolish to feed an ass lettuces when thistles suffice him. He is speaking of the multitude for whom rude, cheap, imperfect food of science is sufficient. Nor ought we to cast pearls before swine; for he lessens the majesty of nature who publishes broadcast her mysteries; nor do those matters remain secret of which the crowd is witness, as is shown in the book of Gems. Aristotle also says in his book of Secrets that he would break the celestial seal if he made public the secrets of nature. For this reason the wise although giving in their writings the roots of the mysteries of

science have not given the branches, flowers, and fruits to the rank and file of philosophers. For they have either omitted these topics from their writings, or have veiled them in figurative language or in other ways, of which I need not speak at present. Hence according to the view of Aristotle in his book of Secrets, and of his master, Socrates, the secrets of the sciences are not written on the skins of goats and sheep so that they may be discovered by the multitude. For the wisest and most expert frequently find very great difficulty in the books of the ancients. When the Philosopher logically divides probability in his first book of Topics, he separates the multitude from the wise; for he says that that is probable which all men think, or the majority of men, or the wise; for under the term *all men* are included the multitude and the wise alike, therefore by the majority of men is meant the multitude; wherefore the insensate multitude has no partnership with the wise. This results not only from its own folly, but from the fact that in most cases it has a dull, weak head, prone to errors and productive of imperfection, at whose nod it is led in every circumstance, as I have noted in the preceding letter. Therefore, the ignorant multitude is never able to rise to the perfection of wisdom, for it is ignorant of the use of the things of greatest worth; and if by any chance it at length attains them, it turns all into evil, and accordingly by God's just judgment the paths of perfection are denied it; and it attains its greatest good when it is kept from sin. Its own name indicates all that has been said about it; for in all authors it is called the ignorant and insensate multitude. Now ignorance consists in error and imperfection, and therefore error and imperfection are native to the multitude, whose error is more frequent than its wish to perceive, however imperfectly, the truth. For many have been called but few chosen for the reception of the divine truth and of the philosophic as well. For the Philosopher says in the second book of Topics that we must think as the few, although we ought to talk as the many, considering the place and time; because to simulate at times the folly of the multitude is regarded as the highest wisdom, especially when it is in its mad mood. Hence from all these sources are inferred the evil and folly of these three causes of error, and their infinite harm to the human race. For this reason they are under suspicion in every case and not to be trusted.

In an especial degree must popular prejudice be disregarded for the special reasons given, not but that at times these causes of error may hit upon the truth, but because as a rule they are involved in what is false; and very seldom do example and habit contain perfection; which moreover the multitude never attains, as I have explained before.

Chapter V

We can have no protection and defense against these evils, unless we follow the commands and precepts of God and his Scripture and of canon law, of saints and philosophers, and of all the ancient sages. If we hold fast to these commands and precepts, we cannot err nor ought we to be condemned in any particular. The philosophical quotations already given were adduced, accordingly, in the first instance to show the viciousness and folly of these evils, on account of which we might be able and bound to avoid them. But for the reasons given in regard to adducing the testimony of philosophers I have as a rule kept silent in other instances; moreover, it amounts to the same thing as if those testimonials had already been given which must now be added. I am able now, however, to give an intimation of the counsels and testimonies in which counsel or command is more clearly given in regard to avoiding those causes of error. Against popular prejudice, then, let us hold fast the command of Exodus, "Thou shalt not follow the multitude to do evil, nor yield in judgment to the opinion of the many, so that thou mayst depart from the truth." Let us follow also the advice of Tully at the end of his book on Questions, "Although thou art in the eyes of the multitude, do not rest upon its judgment nor agree with it in its estimate of what is most beautiful." Seneca also in his work on Aphorisms invites us and consoles us on our departure from the pathway of the multitude, saying, "Not yet art thou fortunate if the throng has not yet derided thee." Moreover against custom let us follow the advice of Cyprian; "Custom without truth is error of long standing, wherefore leaving error let us follow truth." Augustine teaches that if the truth is manifest, custom should yield to truth, because truth and reason always exclude custom. Isidore also says, "Let cus-

tom yield to authority; let law and reason be superior to base custom." For this reason Tully, in his book on the Immortality of the Soul, praising and extolling those who shun custom, says, "It is the mark of a great mind to withdraw its thought from custom." The name of authority, however, is in favor. Therefore our ancestors must be respected whether they possess real authority or apparent authority, which is the authority of the leaders of the multitude. Against the use of apparent authority not only are there proper counsels and commands in accordance with the pathways of God and his saints and philosophers and all men of science, but whatever can be said against the vices of human frailty in real authorities, is applicable to those who abuse assumed authority. Hence if we have counsels and commands against the failures of real authorities, much more so against those abusers of authority. But since truthful authorities, such as saints and leading philosophers, have aided us in the consideration of truth, we must be thankful to them, just as Aristotle in the first book of his Metaphysics is thankful to his predecessors, and at the end of his Elenchi desires to express his personal thanks for their discoveries. Since they have in fact laid the first foundations, we must not only thank them, but we must ascribe to them with a certain amount of reverence credit for the whole structure. Accordingly Seneca maintains in the third book of his Natural Questions, "Whatever has been discovered by men of a later day must none the less be referred to the ancients, because it was the work of a great mind to dispel for the first time the darkness involving nature, and he contributed most to the discovery who hoped that the discovery could be made; and although owing to human frailty they failed in many instances, they must nevertheless be excused." For as Seneca says in the book mentioned, "The ancients must be listened to indulgently."

Chapter VI

But since owing to original sin and the particular sins of the individual parts of the image have been damaged, for reason is blind, memory weak, and the will depraved, and truth and goodness are single, while fallacy opposed to any particular

truth and evil hostile to any particular good are of infinite variety; because as the Philosopher, in the second book of his Ethics, explains, it is easy to miss a given mark owing to the manifold possibility of error, while truth and virtue are exact; also truths and virtues are infinite, and there are innumerable gradations in each truth and virtue; it is clear that the human mind is unable to give what is necessary in all, nor can it avoid fallacy and evil in particular ones. For this reason additions can fitly be made to the statements of real authorities, and corrections applied in many cases. This Seneca shows excellently in his book Quaestiones Naturales, declaring in the third book, "Ancient views are too inaccurate and crude; as yet thinkers were groping their way round truth. All things were new to the first investigators, later those same matters came under the file. Nothing is perfect at its commencement." In the fourth book he says, "The time will come when careful study through long ages will bring to light the secrets of nature. A single lifetime is not sufficient for the investigation of such weighty matters. The people of a future age will know much that is unknown to us, and the day will come when posterity will be amazed at our ignorance of things so clear to them." For this reason Priscan says in the introduction to his larger volume that there is no perfection in human discoveries, and adds, "The younger the investigators the more acute," because the younger, that is those of a later age, in the progress of time possess the labors of their predecessors. Since my contention has been proved by the nature of the case and by authority, I shall now establish it in a third way by the result. For thinkers of a later generation have always added to the work of their predecessors, correcting much and changing more, as is shown in the case of Aristotle especially, who discussed critically all the philosophical propositions of his predecessors. Avicenna also and Averroës corrected many of Aristotle's statements. Aristotle is criticized even yet for his statement in regard to the eternity of the world, which he has left too indeterminate; nor is it surprising, since he himself confesses that he did not know everything. For he confesses that he was ignorant in regard to the squaring of the circle, a problem clearly understood in these days; and his ignorance on this point indicates still further ignorance of more important matters. And Avicenna, the chief authority in phi-

losophy after him, as the commentator states on the chapter on the rainbow in Aristotle's book Meteorologics, and as the works arranged by him from Aristotle into a complete system of philosophy make this clear,—Avicenna, I say, declared he was ignorant of the nature of the rainbow, even as the commentator mentioned confesses. In the third book of the Physics he does not hesitate to say that he is ignorant of one of the ten categories, namely, that of habit [*habitus*]. Without doubt errors and false statements are contained in his book on popular philosophy, as in the ninth book of the Metaphysics an error is set forth in regard to the creation of the world, where it is said that God on account of his infinite unity and the fear of attributing to him a diversity of natures can create but one being, that is the first angel, who created the second with the first heaven, and the second created the third with the second heaven, and so on. Also when he maintains in the tenth book that every sin has its final purification in another life, and that sinful souls in every case return to glory he is clearly in error, and so in many instances. Just as Averroës, the greatest after these, refuted Avicenna in many particulars, so also our men of science correct him in more instances, and rightly so, since without doubt he erred in many places, although he spoke very well in others. Moreover, if those greater masters fell into error, much more so have others, their inferiors, done so. Since, however, they have fallen into errors, they have failed much more seriously in the essentials, by heaping up a mass of superfluous and useless matter, and by spreading abroad doubtful, obscure, and perplexing statements; and all these faults in their books are manifest to any one, and are proved by their effect on us. For we are oppressed by such great difficulty in seeing the truth and stagger along, since as a rule one philosopher contradicts another, so that it is a difficult matter for them to agree on a single question of least import, or on a sophism of the most trivial kind, or process of science, as in medicine and surgery and other scientific fields. But not the philosophers only, but even the sacred authors have been subject to some human infirmity in this respect. For they have retracted very many of their own statements. Hence it is that Augustine, who is considered a master in the investigation of hidden truths, composed a book of retractions of his own faulty statements. Jerome also

in regard to Isaiah, and elsewhere frequently, does not hesitate to retract his expressed opinion. For in the hurry of dictation he confesses he has frequently been mistaken in his translation, and in many other ways; and so with all the other doctors. Even the sacred authors have mutually corrected their own positions, and in turn vigorously withstood one another. Even Paul withstood Peter, as he himself confesses. Augustine finds fault with the views of Jerome; and Jerome contradicts Augustine in many places. This is clear from the examples of these men, and later writers have corrected the statements of their predecessors. For Origen, generally conceded to be the greatest of the doctors, is disapproved of in many particulars by his successors, because among other reasons he maintained the error of Avicenna in regard to sinful souls, namely, that not one of them will finally be damned. After many sacred and famous doctors have explained Israel to mean the man beholding God, Jerome comes in his commentary on Genesis and proves this exposition false by irrefutable reasons, as will be shown below. Hence he states, although they are men of authority, and we sink under the shadow of those who have interpreted Israel as the man beholding God, yet I prefer to agree with God or the angel who gave the name rather than with the author of some uninspired statement. Catholic doctors also grounded in sacred studies have changed at the present time in public utterances many statements made by the saints, expounding the sacred authors reverently according to their ability with due regard to the truth.

Chapter VII

Since then the facts are as stated, we should not give adherence to all that we have heard and read, but we should examine most carefully the philosophical statements of older writers, that we may make up their deficiencies and correct their errors, with all modesty, however, and consideration. We can reach this pitch of temerity not only because of the necessity to avoid failure or error, but through the examples and patterns of these men, so that in no way are we censurable for our presumption. For Plato says, "My master Socrates is my friend, but truth is still

more so"; and Aristotle declares that he would rather be in harmony with truth, than have the approval of Plato's friendship, our very dear teacher. These statements are clear from the life of Aristotle and from the first book of the Ethics and from the book of the Secrets. Seneca says in his book on the Four Cardinal Virtues, "Let not the authority of the speaker influence you. Do not consider who the speaker is but what he says." Boetius in his book De Disciplina Scholarium* says, "It is foolish to put full confidence in the statements of a teacher, for in the first place credence must be given until it becomes evident what he has in mind; later it must be assumed that he made an error in his statement if perchance the pupil is able to find a flaw in the teacher's zealous handling of the subject." Augustine says in answer to Jerome that he is willing to believe that the authors of the sacred Scripture were the only ones who wrote without error, but that in the writings of others, however great their sanctity and learning, he is unwilling to consider there is truth unless they are able to prove their statements by the canon, and by other authors, or by adequate reasons. And in reply to Vicentius he says, "I cannot deny nor ought I that, as in the case of the older writers themselves, so in many of my own works there are many things that may be called in question fairly and without presumption." In the prologue to the third book on the Trinity he says, "In my letters unless you perceive the certainty of a matter, do not retain it as a fact." Likewise to Fortunatus, "Nor ought we to regard the disputations of any, although they be catholic and praiseworthy men, in the same light as canonical Scriptures, so that we may not, while retaining the respect due those men, call in question and reject anything in their writings, if perchance we find that their views have been at variance with the truth as understood with God's help either by others or by us. My attitude toward the writings of others is the same as I desire my readers to assume toward mine." If therefore owing to the necessity of avoiding falsehood and attaining a more perfect state of wisdom we are able and obliged and counseled by sacred writers and worthy philosophers to change their statements, as time and place demand, and to add to their precepts, we have much greater free-

* Not the work of Boetius but of a monk of Brabant of the thirteenth century, by name Thomas (Brabantinus Cantipratanus).

dom in this respect and are urged thereto in matters pertaining to the ignorant throng, and also to its leaders, especially since the popular leaders of this period are not to be ranked in influence with the sacred writers and great philosophers nor with ancient sages, some of whom we have seen in our own time.

Chapter VIII

There is no remedy against these three evils unless with all courage we prefer strong authorities to weak ones, reason to custom, the opinions of the wise to popular prejudice; and let us not trust in the threefold argument, this has a precedent, or is the custom, or the general practice, therefore should be retained. For it is evident from what has been said before in accordance with the opinions of sacred writers and all men of science that the opposite conclusion far more logically follows from the same premises. Although the whole world be influenced by these causes of error, yet let us willingly consider what is opposed to common custom. For it is a great remedy against these evils, according to the statement of Averroës at the end of the second book of his Physics, that evil custom can be removed by the habit of considering what is opposed to it. For he bestows much labor on the opinion which is formed from habitually considering extraneous matters, confirming his conclusion by the result, and saying that for this reason popular opinion is held more firmly than the faith of those philosophizing, because the multitude is not accustomed to consider the opposite side of a question, while those philosophizing take many things into consideration. Therefore let not your Wisdom be surprised, nor your Authority consider it improper if I labor against popular custom and common precedents. For this is the only way of arriving at a consideration of truth and perfection.

Chapter IX

Not only indeed are there these general causes of evil in our vocation and in our life, but there is a fourth one worse than these three likewise common in every rank, and visibly domi-

nating every individual. I have joined together the three causes already mentioned because the wise usually do so, and I have separated this fourth cause from the former ones on account of its especial harmfulness. For this is an extraordinary wild beast, devouring and destroying all reason, namely, the desire to appear wise, by which every man is influenced. For however little and worthless our knowledge we nevertheless extol it; we publish abroad much of which we are ignorant, where we can hide our ignorance, making a clever display that we may glory over nothing. Matters of which we are ignorant, where we cannot make a display of our knowledge, we slight, find fault with, abuse, and bring to naught, that we may not seem ignorant of any matter, glossing over our ignorance like a woman with her finery and meretricious coloring, a foul remedy. Hence we banish by this route from ourselves and from others what is most useful, important, full of every grace, and stable in its nature. This bane, moreover, in addition to its inherent harmfulness reaches the crowning point in its own baseness from the fact that it is the beginning and the source of the three causes of error already mentioned. For owing to excessive zeal in regard to our own feeling and the excusing of our ignorance there arises at once the presumption of weak authority, relying on which we extol what is ours and censure what is another's. Then since every man loves his own labors, we willingly form ours into habit. And since no man errs for himself alone, but delights in spreading abroad his madness among his neighbors, as Seneca says in the book of the Second Epistles, by our inventions we take possession of other men and give our inventions all the publicity possible. It is necessary, however, that these universal causes should be considered first, that error may be avoided and truth shine clear. For in spiritual disease the process is the same as in bodily disease; physicians learn the special and particular causes of a disease through symptoms; but the latter as well the former a knowledge of universal causes precedes, which the physician has to acquire from the processes of nature; since the Philosopher says in his book on Sense and the Sensible that where the principles of natural philosophy end the principles of medicine begin. Likewise accordingly in the cure of ignorance and error, that sane truth may be reached, before taking up the main point at issue the

symptoms and particular causes must be shown; but before all universal causes are required without which neither symptoms nor particular causes show anything. For the pathway of learning from the universal to the particular is formed by nature for us, as the Philosopher says in the beginning of the Physics. For if we are ignorant of the universals we are ignorant of what follows the universals.

This fourth cause, moreover, exercised much evil influence of old, just as it is now found to be doing, a fact I make clear in the case of the theologians as well as in philosophy by experience and examples. For Moses, a most sincere man, received the wisdom of the law from God, against which Pharaoh and the Egyptians and the Hebrew people and all the nations murmured to such a degree that the chosen people of God was scarcely willing to receive this wisdom; and nevertheless the law prevailed against adversaries who neglected and hindered the wisdom they did not learn. In like manner Christ the Lord, proceeding with all guilelessness and without a shadow of deceit, and the Apostles, most sincere men, brought wisdom into the world, who met much opposition solely on account of ignorance of so great a novelty, and at length, although with the utmost difficulty, sacred truth was received. Then when sainted doctors wished to give fluent expositions of the divine law, and with the great force of the streams of wisdom to water the Church, they were reckoned for a long time heretics and inventors of falsehoods. For just as the prologues of the blessed Jerome to the Bible and his other works prove, he himself was called a corrupter of Scripture and a forger, and a sower of heresies, and in his own day was overwhelmed and unable to publish his works; but at length after his death the truth of his translation became manifest as well as his exposition, and were so widely circulated among all the churches, that no vestige of the ancient translation, that of the Seventy Interpreters, which the Church used formerly, can be found. So long as the most blessed Pope Gregory exercised his authority, his books were unassailed; but after his death famous men in the Church tried to have them burned, but they were preserved by a most gracious miracle of God and their wisdom has become manifest to the world along with their sweet truthfulness and devotion in the fullest measure. In like manner all the doctors

of sacred Scripture encounter hindrance to the truth. For in refreshing men's zeal they have always met contradiction and hindrances, and yet truth gains strength and will do so until the day of Antichrist.

The same is true of philosophy. For Aristotle wished to complete the writings of earlier philosophers and to give new meaning to many things; and although a very wise man, he seemed to meet repulse and his wisdom to be under a cloud until almost our own times. For Avicenna was the first to recall to the full light the philosophy of Aristotle among the Arabs. For the rank and file of those engaged in philosophy were ignorant of Aristotle; for few attained even a slight knowledge of the philosophy of Aristotle before the time of Avicenna, a recent philosopher long after the time of Mahomet. Avicenna, moreover, the especial expounder and chief imitator of Aristotle, encountered many revolts on the part of others. For Averroës, a still greater man after these, as well as others, condemned Avicenna beyond measure; but in these times whatever Averroës says has received the approval of the wise, yet he, too, for a long time was neglected and rejected, and called in question by philosophers famous in their vocation, until gradually his wisdom has become clear and generally approved, although on some matters he has spoken less convincingly. For we know that in our own times objection had long been raised in Paris to the natural philosophy and metaphysic of Aristotle as set forth by Avicenna and Averroës, and through dense ignorance their books and those using them were excommunicated for quite long periods. Since the facts are as stated, and we today approve of the men we have mentioned as philosophers and sacred writers; and we know that every addition and increase in wisdom they have made are worthy of all favor, although in many other matters they have suffered a lessening of their authority, and in many matters they are superfluous, and in certain need correction, and in some explanation, it is clear to us that those who during their individual lives have hindered the evidences of truth and usefulness offered to them by the men mentioned above, have erred too far, and have been very harmful in this respect. But they have done this to extol their own wisdom and to palliate their ignorance. Therefore we ought to apply the same argument to our own case, so that when we reject and

revile matters of which we are ignorant, we proclaim our action as a defense of our ignorance, and an exaltation of our scanty knowledge. Therefore let us permit works to be introduced rejoicing in the truth, since without doubt although with difficulty truth will prevail among wise men, until Antichrist and his precursors appear. For the goodness of God has ever been ready to increase the gift of wisdom through a succession of men and to change for the better their philosophic statements in the succession.

Chapter X

But at this point two things are to be discussed, the display of presumed knowledge, and the senseless excusing of ignorance. In regard to the first we ought carefully to consider that since the truths relating to God and his creatures are infinite, and in each there are innumerable gradations, of necessity few facts are known by any one, and for this reason no one should boast of the many things he knows. Since, moreover, our intellect is related to things which are most important as is the eye of the bat to the light of the sun, according to my previous quotation from the Philosopher, there are few things that we really know; for assuredly a subject easily grasped by our intellect is indeed small and of little value, and the difficulty with which the intellect grasps a subject is the measure of the nobility of the subject which is being acquired. But nevertheless all that which our intellect is able to understand and know is small in comparison with those things which in the beginning in its weakness it is bound to believe, such as the divine verities and many secrets of nature and of art completing nature, concerning which no human reason can be given in the beginning; but one must get understanding from God through the experience of the inner light, I mean in the sacred verities of grace and glory, and stirred through the experience of his senses in the secrets of nature and art he must discover their reason.

Moreover, what we believe is far less than that of which we are ignorant; such, for example, are the secrets of God and the hidden things of life eternal which, however, the apostle beheld when caught up to the third heaven, ignorant whether he was

in the body or out of the body, matters so great that a man may not speak of them. Likewise in created things; for on account of the great difficulty besetting our intellect it is certain that never, before God is seen face to face, shall a man know anything with final certainty. Therefore if he lived through infinite ages in this mortal state, he would never arrive with certainty at the perfection of wisdom in the multitude of things knowable. For no one is so learned in nature that he knows how to be certain in regard to all the truths involved in the nature and properties of a single fly, nor does he know how to give the particular reasons for its color and explain why it has so many feet, neither more nor less, nor can he give a reason for its members and properties. It is impossible therefore for man to attain perfect knowledge in this life, and it is exceedingly difficult for him to attain imperfect truth and he is very prone and disposed toward whatever is false and empty. Wherefore man ought not to boast of his knowledge nor ought any one to magnify and extol what he knows. For his knowledge is small and of little value in comparison with what he does not understand but believes, and still smaller in comparison with that of which he is ignorant and does not know either by faith or knowledge. And since in comparison with what a man knows those things of which he is ignorant are infinite, and without any comparison greater and better and more beautiful, he is out of his mind who extols himself in regard to his own knowledge. He especially is bereft of reason who makes a display of his knowledge and tries to publish it abroad as something marvelous. Who, moreover, ventures to boast of his knowledge when the whole pith of it acquired by a man, however studious, through thirty or forty years with very heavy expense and labor, may be shown adequately by written and oral instruction to a teachable boy in the course of one year or in less time? For I have proved this in the case of the boy present, who in the midst of great poverty and with little instruction by devoting scarcely a year to increasing his knowledge has so widened his field that all are surprised who know him. For I say fearlessly that although some may know more about philosophy and languages, and many may excel him in various ways, yet there are none among the Latins,* who surpass him in every respect, and he is a

* Adherents of the Western Church.

match for all of them in some things; in some points he excels them. There is no one among the Latins but may listen with profit to this boy. No one so learned, that this boy may not be indispensable in many ways. For although he has learned all that he knows by my counsel, direction, and help, and I have taught him much by written and spoken word, nevertheless he surpasses me, old man though I am, in many ways, because he has been given better roots than I, from which he may expect flowers and wholesome fruits which I shall never attain. Why then shall I boast of my knowledge? Nor should any one do so, however old he shall grow in study, when this boy will more quickly speed to the high points of knowledge, if he continue to be directed by good counsel just as he has been up to the present time. I do not deny that trained scientists will be able through the excellence that is in them to draw forth more easily and quickly many secrets of knowledge than this boy unaided, because he has not made trial of his own powers, nor does he perceive how much he knows, nor is he able to do anything beyond the fundamentals given him. But just as he has better roots than others, as has been said, so indeed if he should be directed by sane and effective counsel beyond the fullness of the source which he now possesses, no older man could overtake him in the full flood of the streams of knowledge. Since, moreover, wise men feel that they are more lacking than fools are willing to acknowledge in regard to themselves, for this reason we see that the wiser men are, the more humbly are they disposed to receive the instruction of another, nor do they disdain the simplicity of the teacher, but behave humbly toward peasants, old women, and children; since simple folk and the ignorant so reckoned know frequently great facts which escape the learned, as Aristotle shows in his second book on Sleep and Wakefulness. For God's conversation is with simple folk according to the Scripture, and experience renders us certain in this respect, since more secrets of knowledge have always been discovered by plain and neglected men than by men of popular fame, because the latter are busied in popular matters. These matters cannot be the great truths of science, as has been shown in my former statements; and I have learned more useful and excellent things without comparison from very plain people unknown to fame in letters, than from all my famous teachers. I

have proposed therefore to your Wisdom this example, and sent a person not only for the two reasons noted above, but as a convincing proof that no man should glory concerning his own knowledge, nor despise plain men who know how to set forth matters which God has not granted to men famous in science, and to uncover and bring to light many very important secrets of science not yet grasped by scientists.

Chapter XI

A SECOND fault discoverable here is the fact that ignorance obtains a persuasive position. But when truth is assailed, there is the curse and corruption of evil; then the foulness of ignorance increases the more and is revealed more clearly. It increases because it strives to exclude knowledge from itself and from other things; it is revealed more clearly, since it becomes really known in God's sight and in the sight of all holy men, and according to the judgment of every learned man, although ignorance languishes among the ignorant and foolish, they avoid cloaking their own confusion.* In the third place, since a judge is considered to have knowledge of a case, an ignorant man does not possess the authority of deciding matters of which he is ignorant, and for this reason should he affirm or deny, his decision ought not to stand, nay, it should be the more vigorously opposed, because his judgment, whatever it be, proceeds from ignorance which has no authority. Hence if he should speak the truth, he would not seem to be doing so, and his ignorance would mar his statement. For as the book on the Cardinal Virtues says, a statement has no weight in a case where he condemns who ought to be condemned. Therefore whether a wise man in the public estimation or one really so, or a good man or a holy one should affirm or reject that of which he is ignorant, and especially should he do so to excuse his own ignorance or display his supposed knowledge, he should not win assent in this matter, but disdain and contradiction, although he might be deserving of high praise in other respects.

* As Bridges says in his note on this passage, the sense is not clear.

Causes of Error

Chapter XII

I HAVE introduced this cause of all our evils along with the other three particularly for this reason, that we may know that now as in times past many things which are very useful and quite necessary to learning considered absolutely and relatively to the four ways touched upon previously, are denied, neglected, and rejected from ignorance alone; and instead of the vast number of examples to be set forth more at length in the separate divisions of knowledge, I desire now to bring forward certain more important ones. For although the knowledge of tongues and of mathematics is especially necessary to the culture of the Latins, as I have indicated above and shall set forth in the proper place, a knowledge of especial service to the sacred writers and to all the sages of antiquity, we men of today neglect, bring to naught, and reject it, because we are ignorant of those subjects and of their usefulness. Moreover, if certain learned men and sacred writers, either overcome by human frailty or from some rational cause, have neglected certain branches of learning, we men of today obstinately and pertinaciously neglect and reject them, fortifying our neglect with the excuse that learned men and sacred writers neglected them, unwilling meanwhile to consider that in every man there is much imperfection of knowledge both in the case of the sacred writers and of learned men, as has previously been proved clearly and abundantly not only by their examples and authorities, but also by reason and the confirmation of experience. We are not only unwilling, moreover, to consider the human frailty, but not even the cogent reasons many sacred writers and learned men had for avoiding in view of the time and circumstance many useful branches because of men's abuse of them in turning them into obstacles to greater usefulness and safety. Lest, therefore, we should be the cause of our own error, and lest an obstacle to great learning should arise from the fact that we do not understand as we should the ways of the sacred writers and of learned men, we can on the authority of sacred writers and of learned men of old previously given in detail, consider with pious mind and reverent spirit because of the dignity of truth preceding all else,—we can consider, I say, whether the sacred writers and other learned men dis-

played certain evidences of human imperfection, in which whether affirmed or denied we should not imitate them without consideration.

We know, in fact, that not only have they given us counsel and freedom in this respect, but we see that they themselves have stated many things with great authority which they later retracted with greater humility; therefore there lay concealed in them in earlier days a great imperfection. But if they had lived up to the present time, they would have corrected and changed many more things; and it is a sign of this as well as an argument for the principle in question, that later doctors have changed very many of the statements of the sacred writers, and have piously and reverently interpreted them in a sense not indicated by the letter. Moreover sacred writers contended vigorously with one another and sharply criticized and rejected their respective positions, so that we become disgusted at beholding them, and are astonished above measure. This is evident in the letters of the blessed Augustine and Jerome, and in many other ways. For when Jerome compared himself to a tired ox, which plants its foot more confidently because he had grown old in sacred study, Augustine, his junior though a bishop, replied, the pontiff to the monk, that the aged ox plants its foot more confidently, not because of the vigor of its mind, but because of the old age of its body. And when Augustine asked Jerome many questions, the latter said, "You name questions on different subjects, but I perceive in them constant criticisms of my works. I pass by the formal greetings with which you caress my head; I am silent about the blandishments with which you try to mitigate my reproof, that I may come to the real matters at issue; observance of ceremonies, look you, cannot be a matter of indifference, but is either good or bad; you assert it good, I bad; while you avoid one thing, you fall into another; for while you fear the blaspheming Porphyry, you run into the snare of the Ebionite heresy." Many examples of this kind are collected from the books of the sacred writers and of the histories, which not only in the matters involving dispute, but also in the manner of the reproof show much human frailty in sacred writers, where they affirmed what they should not. But it is clear that they so acted from a lack of definite knowl-

edge; therefore their activities in this respect resulted from a knowledge merely apparent and reckoned as such.

Chapter XIII

But not alone from the imperfection of this mortality of ours was much rejected by men to whom we should not obstinately cleave, nay, rather we should piously and reverently interpret them to their own honor according to the laws of truth; many very important matters they neglected for definite reasons. One reason is that they had not been translated into the Latin tongue nor arranged by any one of the Latins, and hence it was not surprising that these men did not consider their value. For all the doctors used the books of Plato, because they had been translated, or because they came upon them in Greek; but the books of Aristotle had not been translated at that time. For Augustine was the first translator and expositor of Aristotle, but he expended his effort on the least important and the first of his works, the Categories; nor was the philosophy of Aristotle at that time known to the Greek philosophers, nor to the Arabic, as I explained before. For this reason the sacred writers as well as others neglected the philosophy of Aristotle, of whom they had no experience, yet they praised Plato. Because, moreover, they perceived that Aristotle opposed the views of Plato, they reject Aristotle in many particulars, and say that he assembled together many heresies; just as Augustine says in his book on the City of God, Aristotle while his own teacher Plato was still alive gathered many into his false system. But, nevertheless, on the testimony of all who philosophize, Plato is known to have been altogether inferior to Aristotle. If, therefore, the sacred writers had seen his philosophy they would certainly have used it, and would have extolled it more highly, because they would not have denied a manifest truth, nor would they have rejected the very greatest for the very least. But from the book of the Categories it is clear how much the sacred writers would have praised Aristotle's great efforts, after extolling highly that little book, which does not possess the value of a single straw in comparison with his knowledge scattered in a thousand treatises. For Augustine himself translated it from Greek into Latin

for his son, and expounded it carefully, bestowing more praise on Aristotle for this mere nothing, than we would for a great part of his knowledge. For in the beginning of the Categories he says, "Although all science and learning are treated of only through speech, yet no able writer, my son, has been found in any race willing to treat of the origin and beginning of speech itself. Therefore the diligence of the philosopher Aristotle is to be admired, who eager to discuss all things began with an examination of that which he knew had been left undone by all and was necessary to all." And at the end he says, "This, dearest son, is what we have prosecuted with joint labor and turned from Greek into Latin to your profit, that from it also you may receive the excellent fruit of a study perfected by us." Moreover Alcuin, one of the expositors of sacred Scripture and a teacher of Charles the Great, praised highly Augustine's translation of the Categories, and in a metrical preface graced it in these terms: "This little book contains the ten words of nature—words which in an astonishing way belong to everything that can enter our perception. Let him who reads praise the wonderful genius of the men of old, and let him be eager to exercise his own in labor like theirs. Now that which it pleased our master Augustine to transfer from the stored wealth of the ancient Greeks with a Latin key I am sending to you to read, great king, disciple and lover of wisdom, delighting in such a gift."

Boetius, long after the sacred doctors, was the first to begin translating several of Aristotle's works. He translated into Latin some works on logic, a few on natural philosophy, and something from the Metaphysics. We do not now possess either the half or better part. For Aristotle was long unknown even to those engaged in philosophy, not to speak of others, as well as of the rank and file of the Latins. But the sacred writers exalt greatly the works on grammar, logic, rhetoric, and mathematics, and use them freely in the sacred writings. Hence Augustine in the second, third, and fourth books on the Teaching of Christ shows that those subjects have application to divine matters, and elsewhere he similarly touches on the same; and the other sacred writers maintain the same view. But concerning the other works they speak rarely and too little, and more rarely, to be sure, show them much neglect, and sometimes

teach that they should be neglected, as we see in Ambrose on the Epistle to the Colossians, and in Jerome on that to Titus, and in Rabinus [*de pressuris ecclesiasticis,**] and so in many other places. But it is clear to all engaged in philosophy and to theologians that these branches are of no value in comparison with the others, nor of any dignity. Therefore if the sacred writers had been practiced in the great sciences of philosophy, they never would have extolled to such a degree the ashes of philosophy, and they would have turned them to sacred uses: for the better and greater sciences are, the more suited are they for divine things. But since only the books on grammar, logic, rhetoric, and mathematics reached their hands, they aided themselves with these according to the grace given them: whatever they could draw from these in a praiseworthy way, they turned more abundantly to the law of God, as is clear in their expositions and respective treatises; and this will be set forth more plainly in its proper place.

Chapter XIV

Then we must carefully consider that although they might have had many of the major sciences, or if they did actually have some of them, yet it was not a time when these sciences were used except in two cases, astronomy for the calendar and music for the divine Office. For the histories make it clear how Eusebius of Caesarea, the blessed Cyril, Victorinus, and Dionysius, the Roman abbot whose instruction the Church now follows, as well as others by apostolic order worked through the laws of astronomy in this matter. But the other major sciences were neglected, and particularly those known to contain the judgments and the sublime works of knowledge. The reason for this was fourfold. For philosophy before the advent of Christ gave laws to the world with the exception of the Hebrews, both concerning divine worship and morals and the laws of justice, of peace among citizens, and of war against the opponents of the commonwealth. Since, moreover, laws of this kind were given as far as human reason could do so, as Aristotle maintains at the end of the Ethics, when he passes to the book of

* An unidentified work.

laws saying, "Let us state now how much of philosophy is possible in human affairs," the leading men of the world under the guidance of philosophers were unwilling to receive the law of Christ, which was above human reason, and for this reason philosophy hindered the entrance of the faith in this particular, that the world under the influence of philosophy feared to agree to a higher law.

But not only in this way did philosophy hinder the faith of Christ, but by right of its own laws concerning the defense of the commonwealth from every opposing view it seemed through decisions regarding matters of the future and the revelation of secrets of the present, and through works wonderful beyond the power of nature and art acting in common,—it seemed, I say, to be contending with preachers of the faith, whose peculiar province it was not through nature and art, but through the virtue of God, to utter prophecy of future events, to bring forth hidden things into the light, and to arouse the miraculous. For that the power of prophecy is able to accomplish great results, which the rank and file not only of the laity, but also of the clergy viewed as miracles, the following will show. Moreover, the rulers of commonwealths everywhere, on the advice of philosophers zealous for their own laws, inflicted on God's saints severe penalties of persecution and death. The art of magic besides was increasing in strength throughout the whole world, and seizing upon men under every form of superstition and religious fraud; and although it was hated by philosophers and fought by them all, as will be shown in the proper place, yet the early sacred writers finding the world occupied with it as well as with philosophy reckoned both as the same art, since both in many ways were hindering the fruit of faith. For as the magicians of Pharaoh withstood Moses, and made the people of Egypt disobedient to God's command, so did the early Church suffer violence through the art of magic. Since magic produced the same effect as philosophy in opposing the work of faith, all censure of the former was directed against the latter, the more important of the two.

Moreover, it pleased God that no human testimony should be given the Church in the beginning, but that the truth of the faith should shine upon the world with such power that it might be proved that on God's authority alone was the truth made

known through witnesses chosen by his command. For these reasons, therefore, philosophy was not only neglected by the Church in the beginning and by God's sacred writers, but also hated, not, however, on account of anything contained in it contrary to the truth. For although it is imperfect in comparison with the Christian profession, nevertheless its power is not hostile to the Christian sect; nay, it is altogether in accord with it and most useful and absolutely necessary to it, as all believe and as I shall show clearly. Not therefore because of any evil in philosophy did the Church of God neglect and reject it in the beginning, but on account of its abusers, who were unwilling to couple it to its true end, that is, Christian truth. For this reason, moreover, the primitive Church was not eager in regard to the translation of the chief sciences of philosophy and accordingly the sacred Latin doctors did not have access to the great principles of philosophy, and conforming themselves to the early Church neglected many things most excellent in philosophy, just as they were neglected in the beginning for the reasons given above, not because of anything false or unworthy that can be found in the power of philosophy. These facts will be established more surely in their proper place by means of God's sacred writers themselves. For it is shown that the holy patriarchs and prophets at the beginning of the world received all sciences from God, to whom he gave that great length of life, that they might be able to make trial of what had been revealed to them, to the end that, when the faith of Christ was introduced and the fraudulence of the art of magic was purged away, the power of philosophy might be advantageously applied to divine things.

Chapter XV

Neither the sacred doctors made use of the splendid sciences of philosophy, nor did their successors, Gratianus, the Masters of sentences and of histories, Hugo of Saint Victor, and Ricardus of the same. For they had not been translated in their times, nor were they in use among the Latins, and therefore these men neglected them, and did not know how to judge of sciences worthy of the sacred mysteries, but from prejudice re-

jected that of which they had no experience, and in many places speak against these sciences, taking occasion to do so all the more from the fact that sacred doctors neglected the same; but they paid no attention to the reasons of the sacred writers, no doubt because these works had not been translated in their time, and because the Church neglected to order them translated for the five reasons touched on previously. Modern teachers of the people, although many important portions of philosophy have been translated, make no use of them, delighting in small and trivial works and neglecting the two better works on logic, one of which has been translated with a commentary of Alpharabius on it, and an exposition of the second made by Averroës has been translated without the text of Aristotle. Far more do they neglect all the rest possessing still greater value, as the nine sciences of mathematics, and the six great natural sciences, comprehending in them many others, and the four very excellent divisions of the morals; and they seek a wretched solace for their ignorance in Gratianus and the other recognized masters who had no knowledge of the parts of philosophy, even as these men have not. They take refuge also in the bald statements of certain sacred writers, since they do not understand the reasons before stated. For the sacred writers after Christ did not take advantage of the great value of philosophy, not because it is contrary to sacred conceptions or unworthy of them, since philosophy can render useful and glorious aid in understanding absolutely theological truths both in regard to the Church of God, the commonwealth of the faithful, the conversion of unbelievers, and the reproof of those foreknown, as will be shown when necessary. And it is so much the more remarkable that a host of modern students neglect important sciences, although they were introduced after Gratianus and others and are used by men of excellent learning; and some are still living who have read them through in the course of their sacred studies.

Chapter XVI

Although I am attacking earnestly those universal causes of all evils, and I could wish that all should be reduced to firm authority and the way of thinking of the learned and experi-

enced, who are few, yet let not your Serenity suppose that I intend to excite the clemency of your Holiness in such a manner that Papal Majesty should attack violently weak authorities and the multitude itself; nor that I in my unworthiness should stir up under the shadow of your glory any trouble over the matter of studies; but that I in my need may gather crumbs necessary to me as they fall from the Lord's table filled with the dishes of wisdom. The greatness of your Power will be able to make provision for itself and its successors in regard to the advantageous fullness of all knowledge not only to be possessed absolutely, but arranged in the four ways mentioned previously. Then when the wisdom of your Fatherhood shall have obtained fuller certainty regarding these matters, the judgment of your authority will be able easily to persuade the studious and wise that, what the rank and file of students cannot receive, those eager for knowledge may rejoice in obtaining; moreover, hope promises as much as suffices the multitude. For Jerome says on Isaiah, "The multitude after learning the truth easily changes its mind." And this is true except when it is in the hands of crack-brained leaders. For although the throng is rather prone to evil, and since it too frequently finds a leader weak, yet unless the leader hinders, it is quite easily directed to imperfect good, because of its own nature it is unstable, and once set in motion cannot preserve a due measure, and for this reason as far as it is concerned easily turns to the opposite view at the direction of its leader; since it is turned by every wind of doctrine, like a reed, and considers that the will of its leader has the force of law. For we see in every gathering of men that the members are moved at the will of the head. For if the leader neglects goodness, those under him fall asleep; if he stirs them to evil, they madly rush into it; if to an imperfect goodness, they likewise hasten without discretion. If, however, he should advise the paths of perfection, the multitude then sniffs at a distance, but is unable to taste nor does it care to do so, nor should this be required of it, as was shown above. But if it should not belong to your time to consummate all universally, your Magnificence will be able to place the foundations, dig out the sources, and make firm the roots, so that the successors of your Holiness may be able more easily to complete what shall have been happily begun.

PART TWO OF THIS PLEA

Chapter I

ACCORDINGLY after the four general causes of all human error have been banished to the lower regions and have been completely removed from this plea, I wish to show in this second part that there is one wisdom that is perfect and that this is contained in the Scriptures. From the roots of this wisdom all truth has sprung. I say, therefore, that one science is the mistress of the others, namely, theology, to which the remaining sciences are vitally necessary, and without which it cannot reach its end. The excellence of these sciences theology claims for her own law, whose nod and authority the rest of the sciences obey. Or better, there is only one perfect wisdom, which is contained wholly in the Scriptures, and is to be unfolded by canon law and philosophy. I make this statement since the exposition of divine truth is made through those sciences. For it is itself unfolded as it were in the palm with these sciences, and yet it gathers within its own grasp all wisdom; since all wisdom has been given by one God, to one world, for one purpose. Therefore this wisdom from its own triple arrangement will obtain unity. But the way of salvation is single, although there are many steps; but wisdom is the way to salvation. For every consideration of a man that does not belong to his salvation is full of blindness, and leads down to the darkness of hell; for which reason many sages famous in this world have been condemned, because they did not have the true wisdom, but an apparent and a false one, whence reckoning themselves wise they became fools according to the Scripture. But Augustine, speaking concerning the Scriptures, says in the second book on Christian Doctrine, if elsewhere there is truth, it is found here; if there is a hurtful thing, it is here condemned. And he wishes the Christian to perceive that, wherever he may have found the truth, it belongs to his Lord, as was said in the beginning. And the truth of Jesus Christ is the wisdom of the Scriptures. Therefore there is no truth elsewhere except that which is contained in that science. Ambrose on the Epistle to the Colossians says, "All knowledge of the science above and of

the creation beneath is in Him who is the head and author, so that he who knows Him should seek nothing beyond, because He is the perfect virtue and wisdom." Whatsoever is sought elsewhere is found here in perfection. Since therefore the Scriptures give us this wisdom which is Christ, it is clear that all virtue is here included. But if wisdom elsewhere is so called and is opposed to this, it will be in error, it will have only the name of wisdom; even though it be not called opposing, it is yet different. But difference, although elsewhere it does not produce opposition, does so here, as is shown on Gospel authority, "He who is not with me is against me." So also is it true of this wisdom that what is not connected with it is proved to be against it, and for this reason to be shunned by the Christian.

Chapter II

This moreover becomes clearer as we estimate and consider the division of the sciences. For if we should try to separate the sciences one from another, we cannot say that theology is not both the science of canon law and philosophy; for under one division of philosophy, namely, moral science, which Aristotle named civil, is contained the civil law, as will be shown below. But canon law is named from the canonical Scriptures, not from others, just as the name shows. The books of the Old Testament are called the canonical Scriptures, as is the practice in the first part of the Decreta in the ninth section, and elsewhere; or the Scriptures are called canonical from this same word canon, for *canon* in Greek is called *regula* in Latin; and the law, canonical as well as divine, is acknowledged to give us the way of living according to rule. But canon law is wholly founded on the authority of Scripture and its expositors, as is clearly shown throughout the whole body of the Decretum and of the Decretals. For either in support of the ordinances of the canons there are brought forward the authorities of the expositors of Scripture, as Augustine, Jerome, Gregory, Ambrose, Isidore, Cyprian, Hilary, and others; or the holy and exalted pontiffs in support of their own decrees cite the authorities and examples of the New and Old Testaments; and hence this law is nothing else but an explanation of the will of God in the Scriptures.

Canon law is likewise called ecclesiastical law, by which the Church of God is ruled in spiritual matters both in its head and in its members. But the Scripture has no other interest outside this direction of the Church. Moreover, the natural law is contained in the Scripture, as is taught in the beginning of the Decretum, but whatever has been accepted in customs or included in writings, if it should be opposed to natural law, must be considered vain and without reason, as is set forth in the first part, eighth section. Therefore canon laws cannot be different from divine law, nay, they must be derived from its sources. The common law, moreover, is either divine or human. It is divine, since it was proclaimed to the world by the mind and spirit of God in his Scriptures; it is human, since it was discovered by the mind of man. But we agree that the Church is ruled by the divine mind and spirit, and therefore by the divine law which is included in the Scriptures, and it is certain that the Church is ruled by canon law. Therefore this divine law must be drawn out of the treasure-house of the Scriptures. This, moreover, is clear if we consider the divisions of canon law. For it orders the gradations of ecclesiastical offices, determines the sacraments of God, discusses the forum of conscience, and settles ecclesiastical cases. But the roots of all these matters and the erect stalk itself are found in the Scriptures; the branches belong to the expositors of the same, so that in the body of the canons are to be had the leaves, flowers, and fruit bringing salvation. For the pleasing embellishment of the language of the canon is compared to leaves according to the Scriptures, but the utility of the flowers and fruits is comprised in the four divisions already mentioned under their appropriate metaphors. And for this reason the canons are merely the golden heads of grain, and the branches, the ripeness of the grapes, are to be offered through the virtue in their own Scriptures. Since therefore canon law is thus subject to Scripture, it is contained in one body, just as the body of a single tree is composed of roots and stalk, branches, flowers, and fruits.

Chapter III

We must show, moreover, both in general and in particular, that the power of philosophy is not foreign to the wisdom of God, but is included in it. After this has been made clear by authorities, examples, and arguments of a general nature, a fuller exposition will then be made covering the four or five divisions of philosophy in regard to the power of the separate sciences and arts. For if Christians ought to snatch from the philosophers as from unlawful possessors the useful facts contained in their books, even as in the beginning I quoted from Augustine, it is evident that philosophy is wholly worthy and belongs to sacred truth. In the same book he says that the gold and silver of the philosophers did not originate with them but are dug out of certain mines as it were of divine providence, which is present everywhere, and he shows that this had been prefigured saying, "Just as the Egyptians possessed vessels and ornaments of gold and silver and raiment, which that people on its departure from Egypt claimed for itself on the ground that it would make a better use of these things; so the systems of the Gentiles contain liberal instruction better adapted to the service of truth and moral precepts of the most useful kind, and some facts are discovered in these philosophers concerning the worship of God himself, and this gold as it were and silver of theirs the Christian should take from them and apply to good use in preaching the Gospel."

And he explains this statement in all matters subject to human management which relate to either morals, or history, or arts, or nature, or logic and grammar. For as regards morals, he says, "The raiment also of those men, that is certain human institutions, but yet adapted to human society, which we cannot do without in this life, must be converted to Christian use." Of matters pertaining to history, he says, "The history of the Gentiles aids us greatly in understanding the Scriptures. For both by means of the Olympiads and the names of the consuls we frequently seek an answer to our questions, and ignorance of the consulship in which our Lord suffered has caused some to err in thinking that our Lord suffered in the forty-sixth year of his age, because it was said by the Jews that their temple had been so many years in building, which was a figure of our

Lord's body." This fact is made clear in almost innumerable places in the New and Old Testament. Concerning other human considerations relating to the arts as well as nature he says, "Of all the other arts, by which something is made or remains after the action, as a house, bench, vessel or any object of this kind, or medicine and agriculture and the art of navigation, or of those activities whose whole effect is the action itself, as dancing, running, wrestling"—a knowledge of these, I say, must be employed in forming a judgment, lest we should be wholly ignorant of that which the Scriptures wish to inculcate when they employ certain forms of expression derived from these arts, and we may take the term *naturalia* in a wider sense so as to include medicine and agriculture. For those sciences are based on nature, and are two of the eight sciences dealing especially with nature, as will be explained below. Yet in general he says in regard to all the natural sciences, "That man would indeed do the Scriptures a kind service who should collect the characteristics of times and places, of stones and the rest of inanimate things, of plants and animals." Moreover, in behalf of logic he says, in the first place, that a training in disputation is valuable in regard to all kinds of questions that must be examined and solved in sacred writings. Elsewhere in the same book he says there is a difference in the case of logic from the other sciences. For certain necessary and important things can be inferred from these sciences on behalf of theology, but I do not see, as he says, whether this can be the case with logic, since it, like nerves, is inferred throughout the whole text of the Scriptures. Also in the third book concerning the order of discipline he says that no one should approach the sacred science without a knowledge of the power of logic. His second, third, and fourth books almost throughout exhort us in regard to the application of grammar to sacred things. Jerome, moreover, in his commentary on the Epistle to Titus, speaking of the usefulness of grammar in regard to theology in comparison with many other sciences, says, "The teaching of the grammarians can benefit life provided it be applied to better uses," a subject concerning which many important statements must be made in what follows. But concerning mathematics, Cassiodorus says in his book on this science, "These four sciences, geometry, arithmetic, astronomy, music, we ponder over with an attentive

mind, they sharpen our perception, they wipe away the mire of ignorance, and produce that speculative contemplation by the gift of the Lord. Rightly do the holy fathers persuade us to read these four, since in a great measure through them our appetite is drawn away from carnal things, and we are caused to desire those things which we can view in spirit only with the help of the understanding." But these matters will be shown fully in their proper place. If such is the case in regard to these sciences, much more is metaphysics in accord with divine utterances. For with the philosophers metaphysics occupies the place of one part of theology, being named by them together with moral philosophy the divine science and the theology of physics, as is clear from the first and eleventh books of the Metaphysics of Aristotle and from the ninth and tenth of the Metaphysics of Avicenna. For it considers many things concerning God and the angels and divine topics of this kind, and thus it is clear that Scripture lays claim to the power of the whole science. But not only Augustine gives us the above instruction, but he states that many sacred writers have done so when he asks, "Do we not see with how great a load of gold Cyprian came out of Egypt, that very sweet teacher and most blessed martyr; likewise Lactanius, Victorinus, Optatus, and Hilary, to be silent about the living; likewise innumerable Greeks, as in former days Moses himself a most faithful servant of God had done, concerning whom it was written that he was learned in all the wisdom of the Egyptians?"

Chapter IV

Not only the blessed Augustine, but other sacred writers as well make this statement, and show that this truth was expressed under a figure and bear witness that the sacred writers so expressed it. For in the present instance I think that Jerome in his letter to the great orator should be cited, "For what reason do you ask why I should sometimes place in my works examples from secular literature and pollute the purity of the Church with the filth of the nations? My reply is a brief one. You would never ask this question unless Tullius had full possession of you; you would not ask it if you read the Scriptures or the com-

mentators on them, omitting Vulcatius. For who is ignorant that in Moses and in the books of the Prophets certain things are taken from the books of the Gentiles, and that Solomon both proposed some questions to the philosophers of Tyre and made certain replies? Hence he warns us at the beginning of the Proverbs that we should understand the discourses of wisdom and the subtleties of words, parables and dark speech, words of the wise and enigmas which properly belong to dialecticians and philosophers. But even Paul the Apostle used a verse of the poet Epimenides, writing to Titus, The Cretans are always liars, evil beasts, idle bellies. In another epistle also he places a senarius of Menander, Evil communications corrupt good manners. Moreover, disputing before the Athenians in the Senate of Mars, he calls to witness Aratus, For we are also his offspring. This quotation is in Greek the close of a heroic verse. And lest this should be too little, the leader of the Christian army and the invincible orator pleading his cause for Christ skillfully turns even a chance inscription into an argument of the faith. For he had learned from the true source that David wrenched a sword from the hands of the foe and cut off the head of very haughty Goliath with his own weapon. For he had read in Deuteronomy a precept from the mouth of the Lord that the head of the woman captive must be shaved, her eyebrows, all the hair and nails of her body must be cut off, and thus must she be taken in marriage. Why then is it strange if I too wish to change secular wisdom on account of the grace of its speech and the beauty of its words from a maid servant and a captive into an Israelite? and if I cut or shave off whatever there is dead in her of idolatrous pleasure, error, lusts, and by union with her very pure body beget servants born in the household for the Lord of Sabaoth, my labor is profitable in the household of Christ. Julianus Augustus vomited forth on his Parthian expedition seven books against Christ; if I shall attempt to write against him, am I to suppose that you will forbid me to drive back the mad dog with the doctrines of the philosophers and of the Stoics, that is with the club of Hercules?" And in his proof of this kind he cites the prophets and all the famous doctors from the beginning of the Church who by the teachings of the philosophers have secured acceptance of the faith of Christ on the part of princes and unbelievers and have strength-

ened it in many ways. Moreover, Bede in his commentary on the Book of Kings says that Christians may apply as their own to divine matters whatever is useful in the liberal sciences. Otherwise Moses and Daniel would not have suffered themselves to be instructed in the wisdom and literature of the Egyptians and Chaldeans. Likewise in his book on building the temple he says that Solomon with his servants signifies Christ, and Hiram with his servants the philosophers and wise men of the Gentiles, so that the temple of God, that is the Church, was built not only on the wisdom of the Apostles, but on that of the philosophers also. The Scripture says, "The servants of Hiram were more skillful in hewing wood than the servants of Solomon." Because, as Bede says on this point, the Gentiles, when converted from error and transformed in accordance with the truth of the Gospel, had a better knowledge of the errors of the Gentiles, and the better their knowledge, the more skillfully did they learn how to overcome and drive them out. Paul had a better knowledge of the Gospel he had learned through revelation. But Dionysius was better able to refute the false dogmas of Athens, the arguments of which, along with similar errors, he was familiar with from a boy, and it is for this reason that Solomon says, "For you know that there is not in my people a man that knows how to hew wood like the Sidonians." These statements and many like them the Venerable Bede makes, and many other writers as well, but let these now suffice.

Chapter V

The reasons can be given why the sacred writers so affirm the point in question and declare that it was set forth in a figure and seized upon in effect by the saints. In the first place the truth wherever found is thought to belong to Christ, as evidenced by the opinion and authorities of Augustine quoted above; in the second place, although in some measure the truth may be said to belong to the philosophers, yet for possessing it the divine light first flowed into their minds, and illumined them from above. For it lighteth every man that cometh into this world, as the Scripture says, with which sentiment the philosophers themselves agree. For they maintain that there is an

active intellect and a possible intellect. The human soul is called possible by them, because it has of itself capacity for sciences and virtues and receives these from another source. The active intellect is the one which flows into our minds, illuminating them in regard to knowledge and virtue, because although the possible intellect may be called active from the act of understanding, yet in assuming an active intelligence, as they do, it is so called as influencing and illuminating the possible intellect for the recognition of truth. And thus the active intellect, according to the greater philosophers, is not a part of the soul, but is an intellectual substance different and separated essentially from the possible intellect. And since it is necessary for the convincing proof of my position to show that philosophy exists through the influence of divine illumination, I desire to prove this point conclusively, especially since a grave error has invaded the rank and file of philosophers in this particular, and also a large number of theologians, for what a man is in philosophy, that he is proved to be in theology. Now Alpharabius says in his book on the Intellect and the Apprehensible that the active intellect, of which Aristotle has spoken in his third book on the Soul, is not matter, but is a separate substance. Avicenna also teaches the same principle in his fifth book on the Soul and in the ninth of his Metaphysics. Moreover, the Philosopher himself says that the active intellect is separate from the possible and unmixed. He likewise maintains that the active intellect is incorruptible in regard to its being and substance, since he says that it differs from the possible in respect to incorruptibility. But the possible is incorruptible in regard to its substance and corruptible in regard to its being on account of its separation. Therefore the active must be incorruptible in regard to its being and substance, for which reason it cannot be part of the soul, since in that case it would be destroyed so far as its existence in the body is concerned when the separation takes place. And he says that it bears the same relation to the possible as the artificer to his material or the light of the sun to colors. The artificer, moreover, is not a part of the material in which he works, and is separate from it in essence. Likewise the light of the sun driving away darkness from colors and other things is separate from them in essence and comes to them from without. He also says that the active intellect knows all things and

is always actual, which is not true of the rational soul nor of the angels, but of God alone. Again if it were part of the soul, the soul would then know the same thing through the active intellect and be ignorant of it through the possible intellect, because the active intellect is in actuality what the possible is in its potentiality, as Aristotle bears witness. Moreover, a thing should be named rather from its more worthy part, therefore the soul must be spoken of rather as knowing through the active intellect than as ignorant through the possible before discovery and teaching. If it should be said that the active intellect, although it be a part of the soul, yet is not the actuality and form of the body as is the possible intellect, and therefore a man has the functions of the possible and not of the active intellect, this is contrary to the definition of the soul in which it is stated that the soul is the actuality of a natural body. For if one part of this only is the actuality, then the form of the body in that case is wrongly granted to differ from the soul as a whole, and the soul is wrongly defined by the expression actuality of the body absolutely and without qualification, and for this reason in that case the part which is not the actuality of the body ought to be excepted, just as Aristotle himself in the beginning of the second book, when he assumes that certain parts of the soul are not only the actuality of the whole body, but of parts of it, for example, the sensitive and vegetative parts of the soul, excepts the intellect, which he says is not the actuality and perfection of a part of the body, because it is not attached to an organ like the other parts of the soul. And to bring out his meaning more clearly he says that the intellect is in the body like the sailor in the ship, since it is not attached to any particular part any more than the sailor is to the ship, although it is the actuality and perfection of the whole. Yet the sailor is not the perfection of the ship, but only its director. Moreover, in that case the soul would be composed of a separate substance and one that is united, but this is impossible. For intellect, or angel, and soul differ according to species as respects capacity or incapacity of uniting with the body, and therefore the soul cannot be composed of something that is the actuality of the body, and of something that is not such. For one species cannot have in its composition something pertaining to another opposite species. Since, therefore, this opinion is in agreement with the truth,

and the text of the Philosopher evidently indicates this, and his chief expositors declare it in this form, and these words active and possible have been accepted by the Philosopher and not by the sacred writers, it is far better in accordance with the opinion of the Philosopher to speak of the active intellect as a substance separate from the soul in essence. For the expert in philosophy has no doubt that this is his opinion, and on this point all the learned experts of the past are in agreement. For when the University of Paris was convoked, I twice saw and heard the venerable president, Master William, bishop of Paris, of blessed memory, in the presence of all express the opinion that the active intellect cannot be a part of the soul; and Master Robert, bishop of Lincoln, and brother Adam of Marsh, and elders of this type supported this same view. How possible objections may be refuted will be explained in the principal work when questions on natural topics are discussed. But, however, lest some caviler may arise on the side, alleging that in which the rank and file are deceived, I reply in the first place that although these words are attributed to Aristotle, "Since moreover in all nature there is something that acts and something that is acted on so is it also in the soul," the translation has often been false and more frequently obscure. For although it is stated in the third book on the Heavens and the World that the circle and the circular figure fill out space, the statement is false, as those know who are expert in the natural and geometrical sciences, even as Averroës proves in the same place. And the statement made in the third book of the Meteorologics that the lunar rainbow occurs only twice in fifty years, is likewise false. For experience shows us that whenever the moon is full and there is rain, and the moon is not covered by clouds, the rainbow appears. So also many other things have been falsely translated, the reason of which will be explained in the third part of this work, when the question of faults in translation will be considered; but far more passages have been translated obscurely and unintelligibly, in which any one may contradict another. In this passage both faults occur or at least the second one, as I shall prove by Aristotle himself. For he says in the second book of the Physics the material cause does not coincide with other causes in the same individual thing, therefore in no nature are there at the same time the active cause and the

material cause, therefore not in the mind. If, therefore, the badly translated text should be held to the letter, then it is altogether false and contrary to Aristotle elsewhere; and so great an author does not contradict himself. And however it happens, his statement in the second book of the Physics is true and accepted by all; therefore his statement in the third book on the Soul is falsely translated, or is in need of exposition. For his thought is that in the soul and in the functioning of the soul two things are needed, namely, the active principle and matter, just as in all nature. That is, in every operation of nature two things are required, namely, an efficient cause and matter, and this is true; but the active principle is always different from matter and outside of it as regards its substance, although it acts upon it. But we can otherwise relieve this passage. For Aristotle in the fourth book of the Physics says that there are eight modes of being in any thing, one of which is that of the moving force in what is moved, because the moving or acting principle is in the matter moved as far as its force is concerned, although not as regards its substance. Thus the active principle is in every nature on which it works, and so in the soul. Thus in no way does it follow that the active intellect is part of the soul as is commonly imagined. This view is altogether trustworthy and confirmed by the sacred writers; for all theologians know that Augustine says in his Soliloquies and elsewhere that the rational mind is subject to God alone in its illuminations and in all important influences. And although angels may cleanse, illumine and arouse our minds in many ways, and though they may be to our minds like stars to the eye of the body, yet Augustine ascribes to God the principal influence, just as to the sun is ascribed the flow of light falling through the window, and the angel is compared to one opening the window, according to Augustine in his gloss on the Psalm, "Give me understanding." And what is more, he maintains in several places that we do not learn any truth except in the uncreated truth and in eternal laws, and this at least has to be understood to denote the effect and influence of the truth upon us; although Augustine not only maintains this, but hints at something else in his words, for which reason some have believed that he is here thinking of greater matters, as is generally known. All this is evidence of the fact that the active principle

illuminating and influencing the possible intellect is a separate substance, that is God himself. Since, therefore, God has illumined the minds of those men in perceiving the truths of philosophy, it is evident that their labor is not opposed to the divine wisdom.

Chapter VI

The third reason why the wisdom of philosophy is reduced to the divine wisdom is that God not only has enlightened their minds for the acquisition of a knowledge of wisdom, but they have secured it from him, and he has revealed, presented, and given it to them. For all wisdom is from the Lord God, just as the authority of Scripture states, because, as the Apostle says, "What is known of God is manifest in them, for God has revealed it to them." Augustine says on John that he gave it to them, and the greatest philosopher Aristotle in the book of the Secrets asserts that the whole of philosophy was evidently given and revealed by God. Also one of the greatest of philosophers, Marcus Tullius, in the first book of the Tusculan Disputations asks, "What is philosophy, as Plato says, but the gift, as I say, the invention of God?" Whence he also says that not even a poet has poured forth a theme filled with weighty meaning without some divine instigation of his mind. Moreover, Augustine in the eighth book of the City of God teaches and approves of what Socrates, the father of the great philosophers, maintained, that a man cannot know the causes of things except in the divine light and by its gift, and any one can prove for himself that nothing in the first instance is discovered by man which is within the range of philosophy. I offer an example in a very small matter; for although the Universals of Porphyry have been pretty adequately explained by him, and elsewhere have been stated sufficiently in logic, metaphysics, and natural and speculative philosophy, yet there is no man so well grounded as not to need in many ways to have teachers and to listen to them for a long time and to study before he knows the whole truth of the Universals. And no one with difficulty learns enough about these before death, no matter how many teachers he may have, as is clear owing to the disagreement of all in this matter:

since some maintain that these exist only in the mind, others that they exist only outside of it, while still others maintain that in respect to being they are in things, but in their universal aspect they are in the mind. Avicenna shows in his commentary on Porphyry that he lacked the sixth Universal and that he made several false statements. If, therefore, ignorance of these exists in any man you please, although he may study throughout his whole life the books of the philosophers, and though he may have honored teachers, much more will he be ignorant of these weightier matters and never discover them for himself without books and teachers. Wherefore of necessity the truth of these matters was revealed to man in the beginning. If also any one, however well versed in the Universals, had handed over the book of Porphyry to oblivion and all things necessary for a knowledge of Universals, and could not have books or teachers, it would be impossible that he should ever unfold the truth of the Universals. I am speaking of the Universals in respect to their true being, as a metaphysician must consider them, and not merely in respect to the puerile teaching of Porphyry and the method of logic. Wherefore any one can consider for himself that revelation is necessary in this direction; and since these are puerile and very small matters, my position will be much stronger as applied to the whole knowledge of philosophy. But what is from God and what he himself has revealed, presented, and given, should be in absolute conformity with his own wisdom.

Chapter VII

But the whole aim of philosophy is that the Creator may be known through the knowledge of the creature, to whom service may be rendered in a worship that gives him honor, in the beauty of morals, and in the integrity of useful laws, because of the reverence due his majesty and the benefits of creation and preservation and of future happiness, so that men may live in peace and justice in this life. For the end of speculative philosophy is the knowledge of the Creator through the creatures, and moral philosophy establishes the dignity of morals, just laws, and the worship of God, and persuades us of our future

felicity in a profitable and glorious manner so far as lies in the power of philosophy. These things are known as facts by those who peruse all the principal parts of philosophy, as what follows will show. Since, therefore, these things are altogether necessary for Christians and are in complete accord with the wisdom of God, it is clear that philosophy is necessary to the divine law and to the faithful who glory in it.

Chapter VIII

Moreover, all sacred writers and wise men of old in their expositions take a literal sense from the natures of things and from their properties, in order that they may bring out spiritual meanings through convenient adaptations and similitudes. This Augustine declares in the second book on Christian Doctrine, taking an example from the word of the Lord speaking to his Apostles, "Be wise as serpents and harmless as doves." For the Lord meant by this, that like the serpent which exposes its whole body in defense of its head, the Apostles and apostolic men should give themselves and their all for Christ their head and for his Faith. For this reason every creature in itself or in its own likeness or in the universal or in the particular, from the highest part of heaven even to the end of it is placed in the Scripture, even as God has made the creatures and the Scripture, so has he willed to place in the Scripture the things themselves that were made for the understanding of its literal as well as its spiritual sense. But the whole purpose of philosophy is to evolve the natures and properties of things, wherefore the power of all philosophy is contained in the sacred writings; and this is especially clear, since the Scriptures far more certainly, better, and more truly comprehend the creatures than philosophical labor would know how to define them. In place of an infinite number of examples let that of the rainbow make this matter clear. The philosopher Aristotle disturbs us by his own obscurities, nor can we get any clear understanding of the subject through him; nor is this surprising, since Avicenna, his particular imitator, the leading philosopher after him, according to the statement of the commentator on Aristotle's chapter on the rainbow in the third book of the Meteorologics, confesses

that he himself did not clearly understand the nature of the rainbow. The reason of this is because the philosophers were ignorant of the final cause of the rainbow; and in their ignorance of the end they are ignorant of those things which pertain to the end, because the end imposes a necessity upon those things that are ordained for the end, as Aristotle maintains in the second book of the Physics. In fact, the final cause of the rainbow is the dissipation of the aqueous vapor, as is clear from the book of Genesis, whence always on the appearance of the rainbow there is a resolution of the clouds into an infinite number of drops, and the aqueous vapors disappear both in the air and in the sea and land; since one part of the rainbow falls into the spheres of water and earth. The disappearance of the aqueous vapor cannot take place through the rainbow except by reason of the solar rays that cause it, for through various reflections and refractions an infinite number of rays are assembled, and the assemblage of the rays is the cause of the resolution and disappearance of the waters, and therefore, the rainbow is produced by multiple reflections. For the rays cannot assemble except through refraction and reflection, as will be shown later in its proper place. From the Scriptural statement therefore of Genesis, "I will place my bow in the clouds of Heaven, that there may no more be a deluge over the earth," we learn the final cause of the rainbow itself, from which the efficient cause and the way in which the rainbow is produced can be investigated. The manner of its production was not clearly understood by the philosophers as their books show us. And such is the case in regard to every creature. For it is impossible for a man to know the ultimate truth of the creature as it is employed in the Scripture unless he shall have been especially illumined by God. For creatures are employed there because of the need of bringing out the truths of grace and glory, concerning which the philosophers were ignorant, and therefore did not attain the ultimate power of knowledge in regard to creatures, as the sacred Scripture contains it in its own vitals. Hence the whole excellence of philosophy lies in the literal sense when philosophy has been adorned with the sacred mysteries of grace and glory, crowned as it were by certain very noble pictures and colors.

Chapter IX

This general proposition can be proved finally by the fact that the full measure of philosophy was given to the same men to whom also the law of God was given, namely, the holy patriarchs and prophets from the beginning of the world. And not only is this necessary for establishing the point under consideration, but also for certifying the whole range of knowledge. For one could not unaided acquire the principles of the sciences and arts, but needed a revelation. If we prove a revelation, we should have no doubt in regard to the secrets of wisdom discovered by the investigators, although we have had no experience in them. But there is no single point within the realm of knowledge so difficult of proof as this, because it is the main foundation of all human comprehension, and objections and doubts frequently present themselves, and authorities and books must be explained more fully than for any other proposition discoverable in the whole range of knowledge. I say, therefore, that the power of philosophy was given by God to the same persons as the sacred Scripture, namely, the saints at the beginning, so that there thus appears to be one wisdom in its entirety necessary for mankind. For the patriarchs and prophets alone were true philosophers, knowing all things, to wit, not only the law of God, but all the parts of philosophy. For sacred Scripture proves this to us with sufficient clearness, stating that Joseph instructed the princes of Pharaoh and taught the old men of Egypt prudence, and Moses was skilled in all the wisdom of the Egyptians. Bezaleel and Aholiab also proved this point, who had a full grasp and knowledge of the things of nature; for with one breath the Holy Spirit illumined them and taught them the whole of nature's power in metals and other minerals. But Solomon, wiser than all preceding or following him, according to the testimony of Scripture, possessed the full power of philosophy. Josephus in the first book of his Antiquities says that since the sons of Adam through Seth were religious men and made by God himself, God granted them a life of six hundred years on account of the glorious parts of philosophy in which they studied, in order that they might know by experience through the length of their life what God revealed to them. He adds that Noah and his sons taught the

Chaldeans the parts of philosophy, and that Abraham entered Egypt and taught the Egyptians. And he adds that Solomon left no part of nature unexamined, but philosophized about all things and clearly set forth his teaching in regard to their properties, and he mentions how Solomon in treating of things singly composed four thousand and five books; and he adds many things which we know nature as she generally functions does not in any way do. Mighty Aristotle, too, under compulsion of truth itself says in the book of Secrets, God revealed all wisdom to his prophets and to just men and to certain others whom he chose beforehand, and illumined them with the spirit of divine wisdom, and endowed them with dowries of science. Subsequent philosophers, Indian, Latin, Persian, and Greek, received from them the beginning and origin of philosophy. For from those men they received and wrote down the principles and secrets of the arts and sciences, because in their writings nothing false is found, nothing rejected by wise men, but only that which is approved. For philosophers and especially the Greeks, because they were more studious, received all from those men. Averroës states in his commentary on the opening portion of his Heavens and World that in the days of the ancients before Aristotle and the other philosophers philosophy was complete—a completion for which Aristotle hoped in his own times. In the introduction to the Construction of the Astrolabe of Ptolemy and in Albumazar in his larger introduction and elsewhere and in others it is stated in many ways that Noah and Shem, his son, enlarged philosophy, and Shem, his firstborn, was particularly eminent in this subject. Then after them came the men who were commonly called philosophers. All the philosophers and famous poets both greater and lesser were after Noah and his sons, and after Abraham. For Aristotle and all the others agree in this that the first to take up philosophy were the Chaldeans and Egyptians, whence he adheres to the opinions of the Chaldean fathers in the eleventh book of the Metaphysics. In Egypt scholastic study began first, as he states in the first book of the Metaphysics. Because although Noah and his sons taught the Chaldeans before Abraham taught the Egyptians, yet study in the regular scholastic method was not begun so quickly, but its method and practice developed little by little.

To the end that all doubt in this matter may be removed, let us consider the descent and succession of unbelieving philosophers and of poets and of all those zealous in regard to the pursuit of wisdom, that we may perceive that after Abraham and his predecessors individuals were found who secured honorably some title to wisdom. For however closely we wish to reckon, Zoroaster discovered magic arts according to Augustine in the twenty-first book of the City of God, and according to all authorities this was generally known; but he was Cham, son of Noah, as Clemens in his book and the Master of Histories and the Historical Mirror state. Then Io, afterwards called Isis, gave letters to the Egyptians, as Augustine states in the eighteenth book of the City of God. Before her time the study of wisdom was not treated of in letters and in writings, although the teaching of the spoken word of Abraham instructed them. This Isis, as Augustine states, is said to have been the daughter of Inachus, first king of the Argives, who reigned in the first year of Jacob and Esau, grandsons of Abraham, as Augustine and the histories state; although some have maintained that Isis came from Ethiopia into Egypt as a queen, and gave them letters, and bestowed many benefits, as Augustine states. But, however, she was not before the times of Inachus, nor is she found in the line of the kings of Egypt in the chronicles. At the same time appeared the virgin Minerva, named Pallas, the discoverer as Augustine says of many things, who is called in the poets the goddess of wisdom. She is also called Athena and Tritonia, as Augustine states. Isidore says in the eighth book of the Etymologies and Pliny in the fifth book that Pallas is called Tritonia from a place called Trito in Africa, and that she lived in the time of the flood which happened in Achaia in the reign of King Ogyges and which therefore bears his name. According to Augustine, Eusebius, and Jerome, also Solinus in his book on the Marvels of the World, Ogyges was a contemporary of Phoroneus the son of Inachus. Inachus, moreover, reigned fifty years and Phoroneus, his son, sixty-one years, in whose time the promise was again made to Jacob, just as to his father, as Augustine states. Therefore Ogyges belonged to the time of Jacob, whence Solinus says that the first deluge in Achaia was in the time of Ogyges and Jacob the patriarch. This deluge was six hundred years before that of Deucalion, as

Solinus likewise states. For as Jerome and Eusebius tell us, the deluge of Deucalion was in the time of Cecrops, king of Athens, in whose reign Moses led out the children of Israel from Egypt. Under Phoroneus moral philosophy began among the unbelievers. For Augustine says that under this king Greece became more famous because of the introduction of laws and judgments. But previously there were customs and laws of living, as is shown by the inhibition of blood, and permission to eat flesh after the flood, and from the sale and purchase by Abraham of the cave, and from circumcision and rites of this kind. The holiness of Abraham and of his fathers infers that just and sacred laws of living were taught by them. And since they perfected less useful sciences, the wisdom of such great men must not have neglected the most useful science of morals. Next Prometheus was foremost among men, distinguished by his title to greater wisdom, who the poets say formed men out of clay, because he had the reputation of being a most excellent teacher of wisdom, as Augustine says in the eighteenth book of the City of God. His brother, as Augustine likewise states, was Atlas, the great astrologer; whence fable finds occasion, as Augustine states, to represent him as bearing up the heavens, although a mountain is called by his name, from whose height rather the idea of his bearing up the heavens seems to have been general. This mountain in the extreme maritime parts of Africa near the Gades of Hercules rises as it were to heaven. But still earlier were the sons of Noah and Abraham, who were skillful astronomers, as Josephus states; also Isidore in the third book and Clemens in the first book make this same statement in regard to Abraham. For these men according to Augustine flourished when Moses was born, and Isidore agrees in the fifth book, saying that Atlas was in servitude to the children of Israel before the birth of Moses. Atlas in fact, Augustine says, was the maternal grandfather of Hermes, the greater Mercury, famous for his skill in the great arts. Because he taught these to men, he was venerated as a god after his death; and, as Augustine states in the eighteenth book, he lived at the time when Moses led the children of Israel out of Egypt. His grandson was Hermes Mercury, who was called Trismegistus to distinguish him from the other Mercury. He was a famous philosopher of Egypt and lands to the south, especially in morals and in those

things known to pertain to worship and divine matters, as Augustine teaches us in the eighth book of the City of God; and this man wrote to Asclepius, as is clear in the book on Divination, which is pretty well known. Aesculapius, the grandfather of this Asclepius, was the founder of medicine among the unbelieving philosophers. But Isidore says in the third book of the Etymologies that Apollo was the father of Aesculapius, who is said to have been the first among unbelieving philosophers to teach the art of medicine. For medicine is ascribed to the father also as far as the first rudiments are concerned, but more generally to the son, because he enlarged this art and taught it in a more definite manner. For Apollo's method was by incantations and remedies of this kind, but Aesculapius relied on the truth of experience, as Isidore states, and he is believed to be the great Apollo, who is imagined by the poets to be among the gods and to give responses in the temple of Apollo on the island of Delos, whence he is called the Delphic Apollo. And yet the inestimable glory of medicine existed before those men, as Aristotle indicates in his book on the Directing of Life—a glory which he ascribes to Adam and Noah more than to subsequent philosophers. And since medicine is more necessary to man than many other sciences, without doubt the sons of Adam and Noah discovered it, to whom the fullness of wisdom was given, and who were permitted to live so long for the sake of completing its study.

Chapter X

After this in the time of Othniel, judge of Israel, Cadmus the Theban reigned, who first gave letters to the Greeks, as is shown in the Cluniac chronicles. Bede also in his smaller chronological work and other writers agree that under Aoth the judge, Amphion the musician flourished. This Aoth was first after Othniel under Deborah and Barak. There was another Apollo, a philosopher, according to the Cluniac chronicle, the founder of medicine, a contemporary of the second Hercules, whose deeds are famous, as Augustine says in the eighteenth book of the City of God. This Hercules in the time of Abimelech the judge laid waste Troy, set up his pillars in India, erected his columns

at Gades, and refusing to bear the pain of his disease cremated himself in the time of Jephthah the judge, as is confirmed by Augustine and the chronicle mentioned. I have spoken of this second Hercules, because there was another Hercules near the time of the greater Mercury who was a little after him, as Augustine states. After him there was a third, who established the Olympian contest, which after an intermission his son Picus restored in the four hundred and eighth year after the destruction of Troy, as Solinus writes. Whence many have been deceived thinking that there was but one Hercules, who did all the things that were written concerning several, as Augustine says. There was a similar mistake in regard to this philosopher Apollo. For all, as Augustine says, reckon him to have been the one who was worshiped as a god in the island of Delos, under the impression that he was one and the same person, whereas the contrary is shown to be the fact by much evidence. For that Apollo who gave responses in temples is found at least to have given a response when the city of Athens was founded, that Athena, who is Minerva, might be worshiped as a goddess, and for this reason this philosopher cannot be he who was worshiped as the Delphic god. But according to Augustine he was the son of Latona, whose sister was Diana. Isidore also makes the same statement in the eighth book. Similarly he does not seem to be the one of whom Jerome writes in the Epistle to Paul which is placed before the Bibles of the Latins. For that one discovers Hiarchus seated on a golden throne and teaching, and this Hiarchus is said to be Abrachis, the astronomer, who lived after the death of Alexander the Great, as Ptolemy shows in the Almagest. And therefore according to this there were three Apollos as well as three Hercules. Then under Gideon Orpheus and Linus won fame, as Bede states. And these men, namely, Amphion, Orpheus, Linus, and such men of their day, were called theological poets, as Augustine says, because they composed hymns to the gods. According to Solinus, Nicostrate, mother of the Roman king Evander, was called Carmentis from her gift of prophecy, who dwelt on the Capitoline hill in Rome, and was first to give the Latins letters. And this, as Bede states, was in the time of Jair, judge of Israel, but according to the Cluniac chronicle it was in the time of the judge who filled that

office seventeen years after Jair. But this question is not within the scope of the present discussion.

On account of the Sibyls and especially the Erythraean Sibyl, who far surpassed all the unbelieving philosophers previously mentioned, the date of the fall of Troy must be settled definitely. For Augustine states in the eighth book of the City of God that many authorities have written that this Sibyl lived in the time of the Trojan war, although others held that she lived in the time of Romulus and Ahaz, or of Hezekiah, king of Judah, as Augustine says. Now the fall of Troy was four hundred years before Romulus. For Solinus proves that Rome was founded in the seventh Olympiad, four hundred and thirty-three years after the Trojan war, as he clearly shows by Hercules and Picus his son mentioned above and by others. And Augustine in the eighth book mentioned above maintains that Troy was captured when Labdon spoken of above judged the Hebrews, whence in the Cluniac chronicles it is stated that Troy was captured in the third year of Labdon. Then in the time of Samuel according to the Cluniac chronicle, but more explicitly in the Deeds of the Greater Britons, lived Homer the famous poet. Then Hesiod the philosopher succeeded Homer before the founding of Rome, as Tullius says in his book of Tusculan Questions. And later came Archilochus in the reign of Romulus, as is stated in the same book, and therefore in the time of Ahaz or Hezekiah, kings of Judah. For in the first year of Numitor, grandfather of Romulus, who was last king of the Albans in Italy, as Augustine states, Rome was founded. And therefore Numitor and his grandson Romulus ruled at the same time, and then the kingdom and name of the Albans ceased, and they were called Roman kings. The king at that time in Judah was Ahaz; or, as some think, Hezekiah his successor, a most excellent and pious king, ruled in the time of Romulus.

Chapter XI

Augustine makes these statements; but in the time of this same Romulus, according to Augustine, Thales is reported to have lived who was the first of the seven wise men. For after the theological poets wisdom increased and men devoted to it were

called Sophists, that is wise men. But according to Bede in his book of Chronologies and according to Isidore in the fifth book of the Etymologies and according to others also, Thales lived in the time of Josiah, who as a natural philosopher examined nature and was an astrologer at the time when the Hebrew people, as Augustine states, were led into captivity. Another of the seven wise men appeared, Pittacus by name and a Mytilenean by nationality and race; and five others were in the time of the captivity, whose names are Solon the Athenian, Chilon the Lacedaemonian, Periander the Corinthian, Cleobulus the Lidian, Bias the Prienean. Of these Solon gave the Athenians laws, for the transfer of which the Roman people sent ten men, and they are called the laws of the twelve tables, as Isidore writes in his fifth book and Gratianus accepts the statement from him. But the four others left nothing in writing, as Augustine says. All these men, however, were called wise according to Augustine in the eighth book of the City of God, who were distinguished from other men in the nature of their life by certain precepts pertaining to right living, and according to Augustine in the eighth book these were the Ionic wise men, that is Greek. But another class of men devoted to wisdom arose after these in the Greek language, which, however, is called Italic, but they came from that part of Italy which in ancient times was called Great Greece. They were called the Italic school because they studied in Italy although they were Greeks and used the Greek language. Those men did not wish to be called wise, but lovers of wisdom, of whom the first was Pythagoras from the island of Samos. When he was asked who he was, he replied that he was a philosopher, that is a lover of wisdom, as Augustine says in the eighth book of the City of God; but in the eighteenth book of the City of God Augustine says that he appeared at the time of the Jewish restoration. According to Tullius in the first book of the Tusculan Questions in the time of the Roman king Tarquin the Proud, the seventh from Romulus and last of the Roman kings, after whom the consuls arose, Pythagoras came into Italy and swayed Great Greece with his reputation, discipline, and authority. For many ages afterwards the name of Pythagoras had such weight that no others were considered learned. This Tarquin, as Bede writes, began to reign in the time of Cyrus, king of the Per-

sians, who released the Jews from captivity, and reigned in the time of Cambyses, the son of Cyrus, and of his two brothers the Magians, and of Darius, in whose second year the temple was built, and at that time Pythagoras was considered famous, as Bede says, and Zorobabel, Aggaeus, Zachariah, and Malachi were renowned as prophets. Pythagoras was taught by Pherecydes the Syrian, as Tullius says in the book mentioned above, who was the first to maintain that the souls of men are immortal. His date is established only by the date of Pythagoras his pupil, although Isidore also says in the first book that Pherecydes wrote histories in the time of Esdras, which might have been toward the end of Pherecydes' own life and in the youth of Esdras. For from the time when Pythagoras was said to have flourished there passed the thirty-six years of the reign of Darius, the twenty-six of Xerxes, the seven months of Artabanus, and the six years of Artaxerxes Longimanus, before Esdras went up from Babylon to Jerusalem. For in the seventh year of his reign on the first day of the first month, according to the Scripture and the chronicle, Esdras set out.

Chapter XII

These two classes of philosophers, the Ionic and the Italic, branched out through many schools and various successors up to the teaching of Aristotle, who corrected and changed the positions of all his predecessors, and attempted to complete philosophy. Archytas of Tarentum and Timaeus named especially among others succeeded Pythagoras. But the leading philosophers, Socrates, Plato, and Aristotle, did not descend from this line, but were Ionians and true Greeks, of whom the first was Thales of Miletus. How the rest succeeded him, Augustine shows in the eighth book of the City of God. For after Thales first came Anaximander his pupil, whose successor was Anaximenes, and these two were in the time of the Jewish captivity, as Augustine states in the eighteenth book of the City of God, and others likewise agree in this. Now Anaxagoras and Diogenes, auditors of Anaximenes, succeeded him under Darius Hydaspes, in whose second year the building of the temple began. Anaxagoras, as Augustine states, had as his successor

Archelaus his pupil, whose auditor Democritus, according to Isidore in the eighth book, and Socrates according to Augustine in his eighth book, is said to have been the pupil of Archelaus. Socrates was born, according to Bede, under Artabanus, who reigned over the Persians for seven years, whom Artaxerxes Longimanus succeeded, in whose seventh year Esdras descended from Babylon. Esdras and Socrates were therefore contemporaries, but Esdras was the older, as is clear from what has now been said. For this reason Augustine says in his eighteenth book that Socrates was after Esdras, that is, later in respect to birth. For when Esdras was influential at the court of the Persian king and among the Jews, Socrates appeared. This is the Socrates who is called the father of the great philosophers, since he was the teacher of Plato and Aristotle, from whom all the schools of philosophers have descended. Now Plato, according to Bede in his larger work on Chronologies, was born under Sogdianus, who reigned for seven months, whom Darius surnamed Nothus, although Bede writes in his larger work on the Chronologies that Plato was born under the same Darius. But in that work he reckons the time of Sogdianus, since it was short, under the reign of Darius. For he joins him in the succession with Artaxerxes Longimanus. Now at Plato's birth Hippocrates was famed as a physician, as Bede states, and at this time we find Empedocles and Parmenides. But Plato, first learning what Socrates and Greece had to teach, as a teacher of Athens sought Egypt and Archytas of Tarentum and Timaeus, and traversed most laboriously that same Italian coast which was called Great Greece, as Jerome states to Paulinus. And against Rufus Jerome writes that Plato, after founding the Academy and teaching innumerable pupils, when he perceived that much was lacking in his system of instruction, came to Great Greece, and there instructed by Archytas of Tarentum and Timaeus of Locri in the doctrine of Pythagoras united his own elegance and grace with teachings of this kind. Plato is placed before all other philosophers according to the sacred writers, because his books reached their hands, and because he wrote beautiful sentiments about God and much about morals and a future life, which accord closely with the sacred wisdom of God, as I shall explain in the part on moral philosophy. For this reason many Catholic writers have thought that he heard

Jeremiah the prophet in Egypt. For he visited Egypt in his search for wisdom and was taught by the barbarian priests, as Tullius writes concerning him in the fifth book of the Academica. But Augustine says that he did not live in the time of Jeremiah. For Jeremiah, as he says in the eighteenth book of the City of God, first prophesied in the time of the fourth king from Romulus, who was called Ancus Martius, and in the time of the fifth king, namely Tarquinius Priscus. Plato, however, did not live at that time, but was born almost one hundred years after the time of Jeremiah, as Augustine states in the eighth book, and he did not, as some thought, find the Seventy Translators in order to receive their instruction. For as Augustine states in the eighth book and Tully in his book on Old Age, Plato died in the eighty-first year of his life, and this was at the end of the reign of Artaxerxes, who was called Ochus, as Bede states; and from the year of his death, as Augustine states, there were almost thirty years to the time of the Seventy Translators. Hence Plato was not instructed in divine matters by them. But Augustine thinks that owing to his desire for knowledge he learned Hebrew and read through the books of the Old Testament, as he shows in his account of the creation of the world which he has represented in conformity with Scripture, and by the name of God which God himself gave in Exodus, "I am that I am," when Moses asked him what his name was. This is the name used by Plato, who states that it is God's name.

Chapter XIII

Before the death of Socrates Aristotle was born, since he was his auditor for three years, as we read in the life of Aristotle. According to Bede he was born under Artaxerxes surnamed Memnon, the successor of Darius Nothus. In his seventeenth year he was an auditor of Socrates and listened to him for three years. After the death of Socrates he became an auditor of Plato, according to Bede, and remained so for twenty years, as we read in his life. After Plato's death he lived twenty-three years. As is clear from the statements made, the extent of his life was sixty-three years. This statement is likewise made in Censorinus' book on the natal day. Censorinus' book states that

Aristotle maintained a struggle against a mortal disease for three years by the greatness of his soul rather than by the virtue of medicine. Aristotle became the teacher of Alexander the Great and on the authority of his pupil sent two thousand men throughout the world to inquire into the secrets of nature, as Pliny tells us in the eighth book of his Natural History, and Aristotle composed a thousand books, as we read in his life. He purged away the errors of preceding philosophers, and enlarged philosophy, aspiring to that full measure of this subject possessed by the ancient patriarchs, although he was not able to perfect each of its parts. For his successors have corrected him in some particulars, and have added many things to his works, and additions will continue to be made until the end of the world, because there is no perfection in human discoveries, as has been shown in what precedes. Nature made this man strong, as Averroës says in the third book on the Soul, that she might discover the ultimate perfection of man. Aristotle, on the testimony of all great philosophers, is the greatest of them all, and that alone must be ascribed to philosophy which he himself has affirmed; whence at the present time he is called by the title Philosopher in the realm of philosophy, just as Paul is understood by the title of Apostle in the doctrine of the sacred wisdom. But the larger portion of the philosophy of Aristotle received little attention either on account of the concealment of the copies of his work and their rarity, or on account of their difficulty, or unpopularity, or on account of the wars in the East, till after the time of Mahomet, when Avicenna and Averroës and others recalled to the light of full exposition the philosophy of Aristotle. Although only some of his works on logic and certain others have been translated from Greek by Boetius, yet from the time of Michael Scotus, whose translations with authentic expositions of certain parts of Aristotle's works on nature and metaphysics appeared in the year of our Lord 1230, the philosophy of Aristotle has grown in importance among the Latins. But in comparison with the vastness of his wisdom contained in a thousand books, only a very small portion up to the present time has been translated into Latin, and still less is in common use among students. Avicenna in particular, the imitator and expositor of Aristotle, and the man who completed philosophy as far as it was possible for him to

do so, composed a threefold volume of philosophy, as he states in the prologue of his book Sufficiency: one part popular in character like the philosophical dicta of the Peripatetics who are of the school of Aristotle; the second part in conformity with the pure truth of philosophy, which does not fear the thrusts of the spears of contradicters, as he himself asserts; and the third part conterminous with his own life, in which he gave an exposition of the earlier parts and collected together the more hidden facts of nature and art. But of these volumes two have not been translated; the Latins have the first in certain parts; which is called the book of Assipha, that is the book of Sufficiency. After him came Averroës, a man of sound wisdom, correcting many statements of his predecessors and adding much to them, although he must be corrected in some particulars and completed in many others. For of making many books there is no end, as Solomon writes in Ecclesiastes.

Chapter XIV

From these considerations the main conclusion is clear, and it is manifest that all unbelieving philosophers and poets and Sibyls and whosoever were devoted to wisdom, appeared after the true, believing, and perfect philosophers, who were the sons of Seth and Noah with their sons, to whom God granted a life of six hundred years to complete the study of wisdom, as Josephus says in the first book of Antiquities, saying that in less time they could not complete philosophy, especially on account of astronomy, in which there is the greater difficulty because mortal men are far distant from the heavenly bodies. But God revealed all things to them, and gave them length of life to complete philosophy through experience. But because of the evil of men, who have abused the paths of wisdom, as in the first instance did Nemroth and Zoroastes, Atlas, Prometheus, Mercurius Trismegistus, Aesculapius, Apollo, Minerva, and the like, who were worshiped as gods because of their wisdom, God darkened the foolish heart of the multitude: and gradually the knowledge of philosophy disappeared until Solomon again recalled and perfected it in its entirety, as Josephus shows in the eighth book of the Antiquities. And again on account of men's

sins the study of philosophy vanished by degrees, until Thales of Miletus took it up again, and his successors broadened it, until Aristotle completed it, as far as was possible for that time. But those men learned all things from the Hebrews, as Aristotle says in the book of Secrets, as was shown above. Since, therefore, the first unbelieving philosophers, as Nemroth, Prometheus, Atlas, Apollo, and others were after Seth and Noah and Shem and Abraham and after their sons who completed philosophy; and since following Solomon, who a second time perfected it, were the rest of the unbelieving philosophers, Thales, Pythagoras, Socrates, Plato, and Aristotle, it is clear that philosophy in its perfection was first given to the holy patriarchs and prophets, to whom likewise was revealed the divine law by one and the same God. This would not have happened unless philosophy were wholly conformable with God's saints and holy law, and useful and necessary for the understanding, execution, and defense of that law. Moreover, a belief in philosophy must be secured, philosophy must be demonstrated, diffused, and enlarged, for it is necessary in all these ways, as will appear on going through the separate parts of philosophy. Therefore philosophy is merely the unfolding of the divine wisdom by learning and art. Hence there is one perfect wisdom which is contained in the Scriptures, and was given to the saints by God; to be unfolded, however, by philosophy as well as by canon law.

Chapter XV

Hence it follows of necessity that we Christians ought to employ philosophy in divine things, and in matters pertaining to philosophy to assume many things belonging to theology, so that it is apparent that there is one wisdom shining in both. The necessity of this I wish to establish not only on account of the unity of wisdom, but because of the fact that we must revert below to the lofty expressions relating to faith and theology, which we find in the books of the philosophers and in the parts of philosophy: so that it is not strange that in philosophy I should touch upon the most sacred truths, since God has given to the philosophers many truths of his wisdom. The power of

philosophy must be applied to sacred truth as far as we are able, for the excellence of philosophy does not otherwise shine forth, since philosophy considered by itself is of no utility. The unbelieving philosophers have been condemned, and "they knew God, and did not glorify Him as God, and therefore became fools and perished in their own thoughts," and therefore philosophy can have no worth except in so far as the wisdom of God required it. For all that is left is in error and worthless; and for this reason Alpharabius says in his book on Sciences that an untaught child holds the same position with respect to a very wise man in philosophy as such a man does toward the revelation of God's wisdom. Wherefore philosophy by itself is nothing, but it then receives vigor and dignity when it is worthy to assume the sacred wisdom. Moreover, the study of wisdom can always continue in this life to increase, because nothing is perfect in human discoveries. Therefore we of a later age should supply what the ancients lacked, because we have entered into their labors, by which, unless we are dolts, we can be aroused to better things, since it is most wretched to be always using old discoveries and never be on the track of new ones, as Boetius says, and as we proved clearly above in the proper place. Christians likewise ought to handle all matters with a view to their own profession, which is the wisdom of God, and to complete the paths of the unbelieving philosophers, not only because we are of a later age and ought to add to their works, but that we may compel the wisdom of the philosophers to serve zealously our own. For this the unbelieving philosophers do, compelled by truth itself as far as it was granted them: for they refer all philosophy to the divine wisdom, as is clear from the books of Avicenna on Metaphysics and Morals, and from Alpharabius, Seneca, and Tullius, and Aristotle in the Metaphysics and Morals. For they refer all things to God, as an army to its chief, and draw conclusions regarding angels and many other things; since the principal articles of the faith are found in them; for as will be set forth in the morals, they teach that there is a God and that he is one in essence, of infinite power and goodness, triune in persons, Father, Son, and Holy Spirit, who created all things out of nothing; and they touch on many things concerning Jesus Christ and the Blessed Virgin. Likewise also they teach us of Antichrist and the angels

and of their protection of men, and of the resurrection of the dead and of future judgment and of the life of future happiness promised by God to those obedient to him, and of the future misery which he purposes to inflict on those who do not keep his commandments. They write also innumerable statements in regard to the dignity of morals, the glory of laws, and concerning a legislator who must receive the law from God by revelation, who is to be a mediator of God and men and a vicar of God on earth, the Lord of the earthly world. When it shall be proved that he has received the law from God, he must be believed in all things to the exclusion of all doubt and hesitation; who must direct the whole race in the worship of God and in the laws of justice and peace, and in the practice of virtues because of the reverence of God and because of future felicity. [We must avail ourselves of their teachings] because they wrote that the worship of idols should be destroyed, and because they prophesied of the time of Christ. From whatever source the philosophers got these statements and similar ones, we find them in their books, as a clear proof will show in what follows, and any one can discover the fact who cares to read through the books of the philosophers. For we cannot doubt that these things were written by them, from whatever source they received them. Nor should we be surprised that philosophers write such statements; for all the philosophers were subsequent to the patriarchs and prophets, as we brought out above in its proper place, and therefore they read the books of the prophets and patriarchs which are in the sacred text.

Chapter XVI

They likewise composed other books, touching on the mysteries of Christ, as in the book of Enoch and in the book on the testaments of the patriarchs and in the third, fourth, and fifth books of Esdras, and in many other books concerning some of which mention is made in the sacred text, as the books of Nathan, Samuel, and Abdon the prophets. For in books of this kind articles of the faith are expressly touched upon, and far more explicitly than in the canon of Scripture. For besides other books the book on the testaments of the patriarchs shows all things

that were fulfilled with respect to Christ. For each patriarch at his death made known to his sons and his tribe and predicted those things which must be believed regarding Christ, as is clear from that book. Although these books are not in the canon of Scripture, yet the sacred and wise Greek and Latin writers have used them from the beginning of the Church. For the blessed Judas received authority from the book of Enoch, and Augustine bases much on that book in order to show that the saints possessed philosophy before the philosophers did, and he says that that book lacks authority more because of its excessive antiquity than for any other reason. Moreover, in regard to the other books it is clear that they were used by the sacred writers and wise men of antiquity because they are known to contain clear truths concerning Christ. The philosophers therefore, curious and diligent in the study of wisdom, traversed many different regions in their search for wisdom, and for this reason read through the sacred books, and learned many things from the Hebrews. For Avicenna in the Foundations of Moral Philosophy quotes the words of Isaiah in regard to life eternal, saying that life eternal is that which eye hath not seen nor ear heard, and he states that charity takes away sin, as the prophet of truth, Tobias, says. Augustine maintains in the eighth book of the City of God that Plato had read the book of Genesis because Plato's description of the creation of the world is similar to that given in Genesis; also that he read the book of Exodus because of the name of God found in it, namely, "I am that I am." For Plato employed this name, and he could not have found it elsewhere, as Augustine agrees. In addition to the sacred prophetic books the patriarchs and prophets composed books of philosophy, nay, they twice perfected the whole of philosophy; and that which the philosophers received exclusively from them, as Aristotle says, has been clearly shown in what precedes. And since there is one complete wisdom, which suffices the human race, for this reason the sacred writers have mingled divine matters with others, as far as philosophy was able to receive them. On this account by means of those philosophic books of the sacred writers the philosophers learned much concerning divine truths.

Chapter XVII

Moreover, since the philosophers themselves were devoted to truths and to every good quality of life, despising riches, luxury, and honors, aspiring to future felicity as far as human frailty could do so, nay, rendered victorious over human nature, as Jerome writes concerning Diogenes in his book against Jovinianus, it is not strange if God, who illumined them in these lesser matters, should give them some light in regard to the greater truths; and that he should do this, if not primarily for them, yet for our sake, that through their persuasion the world might be prepared for the faith. For this purpose he caused many Sibyls to appear, namely, ten prophetesses, as all sacred writers agree, according to Augustine in the eighteenth book of the City of God, and Isidore in the seventh book of Etymologies, and likewise other writers. Moreover, histories and philosophers and poets are in agreement universally in regard to these Sibyls. It is certain that they gave utterance to divine truths respecting Christ and future judgment and matters of this kind. Therefore it is much more probable that the wisest and best philosophers received truths of this nature from God. That the Sibyls uttered divine truths is shown by the sacred writers and otherwise; and it is sufficient to quote what Augustine says in the eighteenth book of the City of God. Now those women gave utterance to statements of this kind; "they will smite God in the face with unclean hands, and will spit out from impure lips poisonous spittle, and he will without guile offer his sacred back to the scourge and will receive the blows in silence, and will be crowned with thorns. For food they gave him gall and for drink vinegar. Foolish race, thou didst not perceive thy God playing with the minds of mortals but thou didst crown him with thorns, thou didst mingle the horrid gall. The veil of the temple shall be rent and in the middle of the day there shall be the darkness of night for three hours. And he shall die, for three days remaining asleep." And again the Sibyl said in verse:

"As a sign of judgment the earth shall be wet with sweat, from Heaven a king shall come destined through the ages, present in flesh to judge the world, whence the unbeliever and

the faithful shall see God on high with his saints at the end of the world. Thus shall the souls with the body be present, that he himself may judge them. Fire shall burn the earth, the sea, and the sky. Flames shall consume the guilty for ever. Each shall then speak disclosing his secret deeds, and God shall bring to light the secrets of the heart. The brightness of the sun is taken away and the chorus of the stars passes away, the sky shall be rolled up, the splendor of the moon shall depart. He shall cast down the hills and exalt the valleys. So likewise the fountains and rivers are parched with fire. The earth yawning shall disclose Tartarean Chaos. Fire and a stream of sulphur shall fall from the heavens."

If therefore weak women spoke in this fashion, much more should we believe that the wisest philosophers had a taste of truths of this kind. Augustine maintains in the eighteenth book of the City of God that others perceived the truth of God besides those who descended one after another from the stock of Abraham up to Christ. For Job knew of the resurrection and the truths of God. And in the chronicles of Eusebius it is written that in the reign of Helena and Constantine a body was dug up, with which was found this written statement, "I believe in Christ; under Helena and Constantine the sun will again behold me." And now in the time of Pope Alexander the Fourth a Saracen in Bozea, despising the world, and devoting himself under his own law to God and virtue and the contemplation of another life, received an angelic visitation advising him to be converted to the faith of Christ, and was baptized by a priest of the Januensian merchants. The fact was known to Pope Alexander and to many, and at the present time very many recall it.

Chapter XVIII

This same conclusion, moreover, can be proved by two principles of metaphysics. For this science deals with what is common to all things and all sciences, and for this reason shows the number of the sciences and the need of another science beyond philosophy, whose principles it touches upon in the universal, although it cannot assign this science in the particular. For phi-

losophy knows its own imperfection, and is aware that it lacks full knowledge of matters regarding which it is most important that it should know, as Aristotle states frequently in the Metaphysics, and Avicenna likewise as we mentioned above, and shall mention again in its proper place. And for this reason philosophy advances to the discovery of a higher science, and proves that it must exist, although philosophy cannot unfold it in its special function; and this science is in its entirety the divine one, which philosophers call the perfect theology, and for this reason philosophy raises itself to the science of divine things. Moreover, philosophers were anxious above all to inquire concerning the verification of a school in which was contained the salvation of man, and they give very clear methods of proving this, as will be shown from the morals. And they find for a certainty that there must be some school trustworthy and sufficient for the world, whose principles they assign, which cannot be found except in the religion of Christ, as is proved in the appropriate places, and it is shown that it accords with the goodness of God and human necessity that this trustworthy school should be known by men. But this cannot be proved to unbelievers by the law of Christ nor by the sacred writers, because following the rule of disputation they can deny all things in the law of Christ, just as Christians deny what is contained in other laws. And since they deny Christ, it is not strange if they deny the authorities of the Christians. Now persuasion in regard to the faith is necessary, but this can be accomplished in only two ways, either by miracles which are above believers and unbelievers, concerning which no one can presuppose, or by the road common to believers and unbelievers, but this is only by philosophy. Therefore philosophy must give the methods of proof of the Christian faith. But the articles of this faith are the principles belonging to theology; therefore philosophy must enter into the proofs of the principles of theology, although less deeply than into the principles of other sciences; and in this way let the subject rest on this reasonable basis until we come to the examination of the schools. For there we shall show that moral philosophy more efficaciously serves theology in this particular, and therefore although in point of truth such matters belong to theology, they are nevertheless philosophical, but because of theology.

Chapter XIX

Moreover, all speculative philosophy has moral philosophy for its end and aim. And since the end imposes a necessity on those things pertaining to the end, as Aristotle says in the second book of the Physics, therefore speculative science always aspires to its own end, and elevates itself to it, and seeks useful paths to this end, and for this reason speculative philosophy is able to prepare the principles of moral philosophy. Thus therefore are the two parts of wisdom related among the unbelieving philosophers; but with Christian students of philosophy moral science apart from other sciences and perfected is theology, which adds to the greater philosophy of the unbelievers the faith of Christ and truths which are in their nature divine. And this end has its own speculation preceding, just as the moral philosophy of the unbelievers has its own. There is therefore the same relation between the ends in view as between the speculations; but the end, namely, the Christian law, adds to the law of the philosophers the formulated articles of the faith, by which it completes the law of moral philosophy, so that there may be one complete law. For the law of Christ takes and assumes the laws and morals of philosophy, as we are assured by the sacred writers and in the practice of theology and of the Church. Therefore the speculations of Christians preceding their own law must add to the speculation of the other law those things which are able to teach and prove the law of Christ, in order that one complete speculation may arise, whose beginning must be the speculative philosophy of the unbelieving philosophers; and the complement of this must be added to theology in accordance with the peculiar characteristics of the Christian law. And for this reason the complete philosophy among Christians must have a much more profound knowledge of divine things than it has among the unbelieving philosophers; and for this reason Christians ought to consider philosophy as if it had just been discovered, so that they might make it suitable for its own end; and therefore many things must be added in the philosophy of the Christians, which the unbelieving philosophers could not know. And there are reasons of this kind rising in us from the faith and from the authorities of the law and of the sacred writers, who are acquainted with philosophy,

and they can form the common points of complete philosophy and theology. And these are recognized by the fact that they must be common to believers and unbelievers, so that they may be so well known, when they are brought forward and proved, that they cannot be denied by the wise and those instructed in the philosophy of the unbelievers. For the unbelieving philosophers are ignorant of many things at present concerning divine matters, and if these were suitably set before them and proved by the principles of the complete philosophy, that is, by the vivacity of reason, which has its origin in the philosophy of the unbelievers, although completed by the faith of Christ, they would receive it without contradiction and would rejoice in regard to the truth set before them, because they are eager for wisdom and are more studious than Christians. I do not say, however, that any one of the special articles of the Christian faith should be received on trial, but there are many common rational truths, which every wise man would easily accept from another, although he might be ignorant of them himself, as every man studious and desirous of knowledge learns many things from another and receives them by rational arguments, although he was formerly ignorant of them.

Those philosophizing should not be surprised, therefore, if they must needs raise philosophy to the level of divine things and theological truths and the authorities of sacred writers, and employ these freely whenever the occasion arises, and prove them when necessary, and by means of these prove other matters; since without doubt philosophy and theology have much in common. The sacred writers not only speak as theologians, but as philosophers, and frequently introduce philosophical subjects. Therefore Christians desiring to complete philosophy ought in their works not only to collect the statements of the philosophers in regard to divine truths, but should advance far beyond to a point where the power of philosophy as a whole may be complete. And for this reason he who completes philosophy by truths of this kind must not on this account be called a theologian, nor must he transcend the bounds of philosophy; since he can handle freely what is common to philosophy and theology and what must be accepted in common by believers and unbelievers. There are many such matters besides the statements of unbelieving philosophers, which belonging as it were within

the limits of philosophy the man philosophizing in the right way should collect, wherever he finds them, and he should assemble them as though they were his own, whether they occur in the books of the sacred writers, or in the books of the philosophers, or in sacred Scripture, or in the histories, or elsewhere. For there is no author who does not besides his main theme introduce incidentally some matters which belong rather elsewhere; and for this reason there is a linking together of sciences, because each thing in a manner is dependent on another. But every one who handles a subject in the way he should must assign what belongs to it, both what is necessary and what befits its worth; and therefore wherever he finds these things he knows how to recognize his own, and therefore he must seize them as his own and arrange them in their proper places. For this reason the philosophizing Christian can unite many authorities and various reasons and very many opinions from other writings besides the books of the unbelieving philosophers, provided they belong to philosophy, or are common to it and theology, and must be received in common by unbelievers and believers. If this be not done, there will be no perfecting, but much loss. And not only must this be done to complete philosophy, but because of Christian conscience which must reduce all truth to divine truth that the former may be subject to and serve the latter; also for this reason that the philosophy of the unbelievers is essentially harmful and has no value considered by itself. For philosophy in itself leads to the blindness of hell, and therefore it must be by itself darkness and mist.

PART THREE OF THIS PLEA

On the usefulness of grammar

Chapter I

AFTER making the statement, therefore, that there is one perfect wisdom, which is contained in the Scriptures and must be expounded by canon law and philosophy, by which the world must be directed, nor is there needed any other science for the advantage of the human race, for it contains in itself the whole power of law and philosophy; I now wish to take up those parts of philosophy which are especially valuable for the exposition of this splendid wisdom. These are five, without which neither divine nor human things can be known, while a sure knowledge of them makes it easy for us to know all things. First, there is grammar, developed in the foreign tongues from which the wisdom of the Latins has sprung. For it is impossible for the Latins to reach what is necessary in matters divine and human except through the knowledge of other languages, nor will wisdom be perfected for them absolutely, nor relatively to the Church of God and to the remaining three matters noted above. This I now wish to state, and first with respect to absolute knowledge. For the whole sacred text has been drawn from the Greek and Hebrew, and philosophy has been derived from these sources and from Arabic: but it is impossible that the peculiar quality of one language should be preserved in another. For even dialects of the same tongue vary among different sections, as is clear from the Gallic language, which is divided into many dialects among the Gauls, Picards, Normans, Burgundians, and others. A fitting and intelligible expression in the dialect of the Picards is out of place among the Burgundians, nay, among their nearer Gallic neighbors; how much more then will this be true as between different languages? Therefore an excellent piece of work in one language cannot be transferred into another as regards the peculiar quality that it possessed in the former. Hence Jerome in his epistle on the best kind of interpretation speaks thus, "If I translate literally, the result is absurd in sound. But if any

one does not think that the grace of a language is changed by translation let him translate Homer literally into Latin. I shall make a further statement; let him translate this same author in his own tongue in the words of prose, he will see a ridiculous order and a very eloquent poet speaking with difficulty." For let any one with an excellent knowledge of some science like logic or any other subject at all strive to turn this into his mother tongue, he will see that he is lacking not only in thoughts, but words, so that no one will be able to understand the science so translated as regards its potency. Therefore no Latin will be able to understand as he should the wisdom of the sacred Scripture and of philosophy, unless he understands the languages from which they were translated.

Secondly, we must consider the fact that translators did not have the words in Latin for translating scientific works, because they were not first composed in the Latin tongue. For this reason they employed very many words from other languages. Just as these words are not understood by those ignorant of those languages, so are they neither pronounced correctly nor are they written as they should be. And, what is bad, owing to their ignorance of Latin they have used Spanish, and other native tongues, to an almost endless extent in place of Latin. For let one example suffice for many from the book on Plants of Aristotle where he says, "*Belenum* which is very harmful in Persia when transplanted to Jerusalem becomes edible." This word is not the scientific one but colloquial Spanish. For *jusquiamus* [henbane] or the seed of the cassilago, is its name in Latin. After being laughed at by my Spanish students, familiar as they were with the words of their own language, when I did not understand what I was reading, I at length learned from them the meaning of this word and of many more besides.

Thirdly, although the translator ought to be perfectly acquainted with the subject which he wishes to translate and the two languages from which and into which he is translating, Boetius alone, the first translator, had full mastery of the languages; and Master Robert, called Grosse-Teste, lately bishop of Lincoln, alone knew the sciences. Certain other ordinary translators, like Girardus Cremonensis, Michael Scotus, Aluredus Anglicus, Hermannus Alemannus, whom we saw in Paris,

have failed greatly as well in the languages as in the sciences; even as this same Hermannus has confessed concerning himself and others, as their translation shows. For so great is the perverseness, crudity, and terrible difficulty in the translated works of Aristotle that no one can understand them, but each one contradicts another, and false statements are found again and again, as is clear from a comparison of the different translators and of the texts of the different languages. Likewise in the sacred text false statements are found and many bad translations. For Jerome proves that the translation of the Seventy Interpreters and of Theodotion and of Aquila had many errors; and since these errors were published throughout the whole Church, and all men stood for the translation of the Seventy as for their own life, Jerome was considered a falsifier and a corrupter of the Scriptures, until little by little the truth of the Hebrew became clear when turned into Latin by the sainted Jerome. Lest, however, he should hinder the Latins by too much alteration, for this reason, as he himself writes, he sometimes adapted himself to the Seventy Interpreters, sometimes to Theodotian, sometimes to Aquila; and therefore has left much as it was translated by others, and for this reason many false statements have remained. For, as Augustine proves in the second book on Christian Doctrine, the translation given in the book of Wisdom is a bad one, "Spurious vines will not produce deep roots." For it should be, Spurious plantings, or adulterous plantings, as Augustine proves by the Greek. And yet Jerome let this pass like many other places for the peace of the Church and of the doctors. And it is clearly known that Jerome, subject to human frailty, sometimes erred in his own translation, as he himself frequently confesses. For since he had made a bad translation of the nineteenth chapter of Isaiah, he takes it up again in the original in the fifth book saying, "In this place also which we translated *curving* and *bridling* we can say *curving* and *frisking*. But while hastily translating what was written, deceived by the ambiguity we translated the Hebrew word *acmon* as *bridling*." He also again considered another place which he had translated badly in the same chapter saying, "I think it better to censure my error rather than while blushing to confess my ignorance to persist in the error. In the passage which I translated, 'and the land of Judah shall be a festivity to

Egypt,' the reading in Hebrew is *agga* which can be translated both as *festivity,* whence *aggeus* is translated as festive, and as *fear,* which Aquila has more significantly translated by *girosin,* since any one fearful and afraid turns about his eyes and fears a coming foe. Therefore if we wish to take it in a good sense that the recollection of Judah is a joy to Egypt, festivity is the right word: but if, as I judge, the idea is one of fear instead of joy we translate it terror or fear."

Chapter II

The fourth reason for this condition is the fact that the Latins up to the present time lack very many philosophical and theological works. For I have seen two books of the Maccabees in Greek, namely the third and the fourth, and Scripture makes mention of the books of Samuel and Nathan and Gad the seer, and of others which we do not have. And since the whole confirmation of sacred history is given by Josephus in his books on Antiquities, and all the sacred writers take the fundamentals of their expositions from those books, it is necessary for the Latins to have that work in an uncorrupted form. But it has been proved that the Latin codices are wholly corrupt in all places on which the import of history rests, so that the text is self-contradictory everywhere. This is not the fault of so great an author, but arises from a bad translation and from the corruption by the Latins, nor can it be remedied except by a new translation or by adequate correction in all fundamental points. Likewise the books of the great doctors like the blessed Dionysius, Basil, John Chrysostom, John of Damascus, and of many others are lacking; some of which, however, Master Robert, the aforesaid bishop, has turned into Latin, and others before him translated certain other works. His work is very pleasing to theologians. If the books of these authors had been translated, not only would the learning of the Latins be augmented in a glorious way, but the Church would have stronger supports against the heresies and schisms of the Greeks, since they would be convinced by their own sacred writers whom they cannot contradict.

Likewise almost all the secrets of philosophy up to the pres-

ent time lie hidden in foreign languages. For as in many instances only what is common and worthless has been translated; and much even of this character is lacking. For lines almost without number, chapters, parts of books, and whole books are omitted in the works on metaphysics, nature, logic, and on other topics, besides great secrets of the sciences and of the arts and the hidden things of nature that have not yet been translated. Such is the second philosophy of Avicenna, which he calls oriental, which is devoted to pure philosophy, and does not fear the thrusts of the lances of contradicters, and the third, conterminous with his life, in which he collected secret experiments, as he noted in the introduction to his first philosophy. Likewise, although Aristotle completed the eight principal parts of natural philosophy containing in them many sciences, we do not have all of the first part, and almost nothing of the others. And in the same way although he himself completed the nine sciences composing mathematics, we have no part of his text. What we have on metaphysics can be reckoned of no value on account of many grave defects. Although there are five great sciences composing morals, we have only the first and a little of the second. Also there is missing from his logic a book better than the others, and the book next in excellence to it has been badly translated, and cannot be known, nor is it in general use, because it has come only lately into the hands of the Latins in a defective and rough translation. Nor is it strange if I call those books of logic better, for of necessity there must be four true arguments; for two stir the speculative intellect or reason, namely, the dialectic, through the feeble and initial habit of the mind, which is opinion, so that we are disposed toward knowledge, which is the complete and final habit, in which the mind is at rest in its contemplation of truth. And this habit of the mind is acquired by the demonstrative argument. But since the will or active intellect is nobler than the theoretical and virtue united with happiness excels infinitely pure knowledge, and is without comparison more necessary for us, we must of necessity have arguments to arouse the active intellect, especially since we are weaker in this particular than in theory. For we all gladly taste of the tree of the knowledge of good and evil, but approach with difficulty the tree of life, that we may embrace the noble virtues for the sake of future

felicity. Therefore the active intellect must of necessity have its own aids, and be aroused by its own proper arguments just as the speculative intellect by its arguments. And for this reason it was necessary that the teaching in regard to these arguments should be handed down, which moral philosophy and theology employ freely. For as the speculative sciences rejoice in the speculative arguments of opinion and pure knowledge, so the active sciences, as theology and active moral philosophy, consider arguments by which we are aroused to action, that is, to good works, and are turned to a love of eternal felicity. And here there are two ways of turning us. One is that which influences the mind to belief, agreement, pity, compassion, and acts of this kind; and to their contraries when there is need; and this argument is called rhetorical, and is related to the active intellect in the same way as the dialectic argument to the speculative intellect. For it causes the weak habit, namely, the persuasion of credulity and faith, to be followed by the complete habit, which is the love of what is believed and affection strengthened by opinion. And this habit, which turns us to the love of good works, is secured by the poetic argument, because true poets, like Horace and others, Greek and Latin, attack vices and magnify virtues, so as to attract men to a love of good and a hatred of sin. For as that famous poet says, "Poets wish either to benefit or please. He has won full approbation who has mingled the useful with the sweet."

For he confers no small benefit on his fellow citizens who delights them in the subject of morals. For it is necessary not only to teach, but to delight and urge forward. Hence the poet as well as the orator ought to do these three things, that by teaching he may render his hearers docile, by delighting them he may make them attentive, and by urging or turning them he may force them to work. These arguments are most potent in matters pertaining to salvation, but in purely speculative matters are impotent; just as demonstration is most effective in pure theory but wholly impotent in practical matters and in those pertaining to salvation. Accordingly Aristotle says in the first book of the Moral Philosophy that it is equally a fault for a mathematician to use a rhetorical argument and for a rhetorician to try a demonstration, since, as he says in the second book, this science does not exist for the sake of mere contempla-

tion but for the purpose of making us good. Aristotle therefore composed books on these arguments, and Averroës and Alpharabi expounded them in their commentaries, and Avicenna instructs us in his works on logic about these arguments. Alpharabius in his book on the Sciences states that two parts of logic ought to consist of these two arguments, because logic alone ought to teach the nature of arguments and how they are composed for the use of all other sciences; and then logic serves the speculative sciences by two arguments, the dialectic and the demonstrative. Moreover, it furnishes practical arguments to morals. And because theology and canon law determine morals and laws and rights, therefore these two arguments are necessary to them, and every theologian and jurist and moral philosopher makes use of these arguments of necessity, by custom and practice, whether his plea be made to prelate, or prince, or judge, or people, or private individual, although the Latins do not yet possess the knowledge of these arguments as regards the force of the art of logic. How these arguments are composed we need not state at present; but in the work which your Beatitude has demanded they must be explained. There is nothing, however, in regard to the speculative sciences more useful in proving the faith to unbelievers, that they may be converted to a belief in the Christian faith and to a love for it; and likewise that we may be skillful preachers to all who are in need of preaching, and so also in regard to the other forms of persuasion useful for salvation. We are, moreover, greatly aided by Augustine in the third and fourth books on Christian Doctrine and by the works of Tullius and Seneca, and by their letters and certain other facts that can be collected in the Latin language concerning these arguments, although the text itself of Aristotle is lacking to us.

Chapter III

There is a fifth reason in addition, because the sciences were formed and expounded with the same idea, and therefore since the sciences were given to the Latins from other languages, all the sacred writers and Latin philosophers who expound the sciences have used copiously other languages, and multiply for

us words without end in Greek, Hebrew, Chaldean, and Arabic, besides those contained in the texts. We are the sons and successors of the sacred writers and of the wise philosophers, like Boetius, Pliny, Seneca, Tullius, Varro, and other men of wisdom even up to these latest times. For we saw certain men of the past who labored much in languages, like Master Robert, mentioned above, the translator and bishop, and Thomas, the venerable president of Saint David, lately deceased, and brother Adam of Marsh, and Master Hermann, the translator, and certain other men of science. But since we do not imitate them, we therefore lack a grasp of the sciences to a degree past belief, because we cannot understand their authentic expositions and consequently we are unable to gain an understanding of the sciences. I offer two examples to serve for many. Jerome says in the prologue to his commentary on Daniel that Daniel and Esdras are written in Hebrew letters but in the Chaldean speech, also one pericope of Jeremiah. Now all theologians state that this pericope consists of the Lamentations of Jeremiah, because pericope is the same as small part. But all Hebrews know that the Lamentations are written in Hebrew letters and in the speech of the Hebrews. Any one who knows anything about Hebrew can perceive this; hence the boy here is not ignorant of this fact. Then we can mention this pericope from the tenth chapter of Jeremiah, where it is said, "Thus therefore shall ye say unto them, Let the Gods that have not made the heavens and the earth perish from the earth and from those things which are under the heavens." For this passage alone in Jeremiah is written in the Chaldean language, as all Hebrew scholars know. It is certain that the Chaldean and the Hebrew have the same tongue but a different dialect, like the Gaul and the Picard; for dialect is the particular form of a language determined by a nation. Hence the Hebrew says *Heloim* for God or Gods, the Chaldean says *Heloa,* and for heaven or heavens the Hebrew says *Samaim,* the Chaldean *Samaa,* and for *not* the Hebrew says *lo,* but the Chaldean *la;* and thus there are accidental differences in the same language. Such is the case in the pericope mentioned above. Yet before this pericope is written here in Hebrew and Chaldean, the Hebrew alphabet must be given in order that the subject under discussion may be more easily understood. The letters of the

Hebrew alphabet are written first, then in the line above are given their names, and last our letters corresponding to the Hebrew ones, in order that we may know the value of the letters and the sounds indicated, some being vowels and some consonants.

z	v	e	d	g	b	a	m
zain	vaf	he	dalet	gimel	bet	aleph	mem uverte
ן	ו	ה	ד	ג	ב	א	מ

l	ch	ch	i	t	h	s
lamet	chaf	chaf	iot	teis	heis	sazake dreite
ל	ך	כ	י	ט	ה	ץ

s	a	s	n	n
sazake torte	ain	samech	nun dreite	nun torte
צ	ע	ס	ן	נ

m	t	s	r	k	p	p
mem close	taf	sin	ris	kof	pe	pe
ם	ת	ש	ר	ק	ף	פ

There are six vowels, *aleph, ain, he, heth, iot, vav;* the rest are consonants; *he* and *heth* are aspirated, *he* at the beginning, *heth* not only at the beginning, but at the end, and *heth* is produced in the throat, *he* in the mouth. *Aleph* likewise in the mouth and *ain* in the throat. But we must bear in mind that *iot* has only one sound, namely, j, like our j, and becomes a consonant and vowel like j with us. V, as Jerome says in his Hebrew Questions, has a double sound, namely our v and o. The remaining four have the sound of our five vowels, namely, a, e, i, o, u, as is shown by Jerome in the book of interpretations. This difference of sounds they indicate by points and dashes. For if under *aleph* a line be drawn without a point thus, אַ or with a point under the line thus, אָ, the sound is a. But if two points are made lying under the *aleph* crosswise, אֲ, or two vertically, אֱ, or three like a triangle, אֳ, or five points in this way, אֵ, the sound is e. But if

three points lying under *aleph* descend obliquely thus, אֳ, the sound is u. If one point be placed under the letter, אִ, the sound is i. But if a point be placed above it, the sound is o, thus, אֹ. The same is true of *ain* and *he* and *heth,* which have these five sounds by means of difference in pointing. When *vaf* has the sound of u, there may be the sign of the three points, as stated, thus, וֳ, or one point may be placed in its bosom thus, וּ. The letters for the vowels are not often written, but the vowel signs mentioned above take their place. Therefore we must note that they attach these signs to the consonants to indicate what vowel sound is to be joined in the syllable with the consonant. If I wish to indicate *ba, be, bi, bo, bu,* I must write,

ba	be	bi	bo	bu
בַ	בֶ	בִ	בֹ	בֻ

There are likewise other signs indicating strengthened or weakened sounds of the consonants. Hence when a dash is placed above the letter it is weakened; when a point is placed in its bosom the letter is strengthened. Hence when a dash is placed above *daleth* thus, דַ, a weakened sound is indicated like our z, as when I say, *adamas.* But when a point is placed in its bosom thus, דּ, the sound is strengthened, as when I say, *dabo.* And thus we here find in this Hebrew which follows

dii	eis	dicetis	sic	
elaa	lehom	temerun	chidena	Hebrew letters
אֱלָהִיא	לְהוֹם	תֵּאמְרוּן	כִּדְּנָה	Chaldean tongue

non	terram et	coelum	qui
la	areka ve	semaa	di
לָא	וְאַרְקָא	שְׁמַיָּא	דִּי

terra de	pereant	fecerunt
area me	iebedu	ebadu
מֵאַרְעָא	יֵאבְדוּ	עְבַדוּ

coelo	semaa	שְׁמַיָּא׃

sub de et	thehot mi u	וּמִתְּחוֹת

dii	eis	dicetis	sic	
elohim	lahem	tomeru	co	Hebrew letters
אֱלָהִין	לַהֵם	תֵּאמְרוּ	כֹּה	Hebrew tongue

fecerunt	non	terram et	coelum	qui
asu	lo	ares ve	samaim	eser
עֲשׂוּ	לָא	וְאַרְעָא	שְׁמַיָּא	אֲשֶׁר

sub de et	terra de	pereant
thahat mi u	eres me	iobedu
וּמִתַּחַת	מֵאַרְעָא	יְאבְדוּ

isto	coelo
ele	samaim
אִלֵּח׃	שְׁמַיָּא

There is therefore a manifest and wretched error on the part of all in this matter owing to ignorance of these languages. Another example is taken from Greek. Since many Greek examples will be given in what follows, I wish for this reason to give here the Greek alphabet with the diphthongs which they use in writing: for what I have to say will be made clearer by this means.

a	b	g	d	e
alpha	vita	gamma	delta	e. penti, *i.e.* quintum
α	β	γ	δ	ε

z	i	th	i	k	l	m	n
zita	ita	thita	iota	kappa	labda	mi	ni
ζ	η	θ	ι	κ	λ	μ	ν

x	o	p	r	s	t
xi	o. micron	pi	ro	sima	taf
ξ	o	π	ρ	σ	τ

y. Greek among Latins	ph	ch	ps
y. psilo	phi	chi	psi
υ	ϕ	χ	ψ

o
o.mega, *i.e.* magnum
ω

There are seven vowels, counting the different letters, since there is a threefold i and a twofold o. But there are only four vowels possessing a principal sound, namely, a, e, i, o. The diphthong with the Greeks is a union of two vowels with the sound of one, or a vowel with a consonant; and the final letters in the diphthongs of the Greeks are *iota* and *ipsilo*. *Ipsilo* therefore can follow *alpha* thus, $\alpha\upsilon$, and then the sound is like a with υ consonantal, a sound somewhat similar to the sound of a itself with f, and therefore we commonly explain the sound as that of *af;* or it can follow e thus, $\epsilon\upsilon$, and then the sound is like e vocal with υ consonant, and like *ef,* as was stated in regard to *alpha* and *ipsilo;* or it can follow *ita* thus, $\eta\upsilon$, and sounds like *if,* as was stated concerning the others; or *ipsilo* can follow *o micron* thus, $o\upsilon$, and then it has the vowel sound of u; and in this case only do the Greeks have the sound of this vocal u. If *iota* follows *alpha* thus, $\alpha\iota$, then the sound is e; if it follows e thus, $\epsilon\iota$, then the sound is i through the *iota;* if it follows o thus, $o\iota$, it has the y sound through the *ipsilo*. It can also follow *ypsilo* itself, thus, $\upsilon\iota$, and then it has the i sound with the *ipsilo*. These eight diphthongs are called proper diphthongs. But three are called improper, and are made by writing this letter *iota* beneath *alpha, ita,* and ω *mega,* thus, $\alpha\iota$, $\eta\iota$, $\omega\iota$. Sometimes, however, *iota* is placed on the line after the letter as in other diphthongs, thus, $\alpha\iota$, but in improper diphthongs the sound never alters, but remains that of the principal letter, that is, of the letter beneath which the *iota* is written. For when it is written beneath *alpha,* the sound is a; when beneath *ita,* the sound is *ita;* when beneath ω *mega,* only the ω *mega* sounds.

The Greeks use these three diphthongs always in the dative case of the first and second declensions.

Now the example in the present instance is concerning Jacob, who meeting his brother Esau coming from Mesopotamia said, "For thus I beheld thy face, as the face of God." Augustine asks in the book of Questions, and it is in the gloss, how a holy man could compare an evil one to God and reckon him as God. He answers the question with the statement that the word God is used in Scripture in many ways, sometimes for the true God and sometimes otherwise; but the Seventy Translators, in order to point out that he was not speaking of the true God, added the article to the name of God. For the article has the property of showing the truth of a thing; but this force does not appear in Latin, since it lacks the article. But it does appear in the Gallic tongue; and hence when they say in Paris, *li reis vient,* the article *li* designates the particular and actual king of such a place, since they are speaking of the king of France. This would not suffice to denote the arrival of the English king to the city of Paris. For no one would say of the English king's coming to Paris, *li reis vient,* but would add something, *li reis de Engleterre vient.* Therefore the article alone suffices to designate the truth and property of the thing under discussion. For this reason Augustine says that the Greek runs thus, προσωπον θεου, which in Greek has the sound *prosopon theu* without the article; and not thus, προσωπον του θεου. *Prosopon* here signifies countenance or face, *theu* is the genitive case of this noun *theos,* that is, God, and *tu* is the article in the genitive. There is great need, therefore, that the Latins should know languages on account of the sayings of the sacred writers and of other men of science.

Chapter IV

The sixth reason is the correction of errors and false statements without end in the text of theology as well as philosophy, not only in the letter, but in the sense. That, moreover, correction is necessary I prove by the great amount of corruption. Since the error in the text of God is more serious and dangerous than in the text of philosophy, I shall therefore apply the power

of languages to the corruption of the sacred text, that the necessity of these may appear, owing to the endless corruption of the edition in common use, that of Paris. God knows that nothing can be brought before the Apostolic Seat in need of such vigorous correction as this endless corruption. For the letter in the common text is everywhere false or in doubt for the man who has taken this corruption into account, and if the letter be false or in doubt, then the sense, spiritual as well as literal, will contain falsehood and inexpressible doubt. This I now wish to show without possible contradiction. For Augustine says against Faustus, "If there is disagreement in the Latin codices, we must have recourse to the ancient ones and to several of them." For the ancient ones, as he thinks, are to be preferred to the late ones, and the larger number to the fewer. But all the ancient Bibles, which lie everywhere in the monasteries, and which up to the present time have not been glossed nor touched, have the true translation, which the holy Roman Church received in the beginning, and ordered spread abroad throughout all the churches.

But there are many contradictions in the edition of Paris. Therefore this edition needs a thorough correction by means of the ancient texts. But Augustine says in the same work that if a doubt still remains in the ancient Bibles, we must then have recourse to the Hebrew and Greek languages. He also makes this statement in the second book on Christian Doctrine, and shows it in examples. Jerome also imparts this teaching to Frecella and Sunnia and so states in the commentary on Zachariah, and all the sacred writers agree in this, and any one else with reason. But Greek and Hebrew along with the ancient Bibles stand in opposition to the Paris edition, and hence it is in need of correction in many places. But Jerome says to Damasus in this event that where there is diversity, the truth is not known. But those who are striving with all the truth they know to correct the text, namely, the two orders of Dominicans and Franciscans, have now formed from the corrupted text various scriptures and more than one Bible may contain. They contend with each other and contradict without end; and not only the orders, but the brothers of both orders, oppose one another even more than the orders as a whole. For every house contradicts another, and in the same house correctors succeeding one another in

CLEMENT IV

From *Effigies Pontificum Romanorum Dominici Basae*

turn destroy their mutual positions with infinite scandal and confusion. Hence although twenty years before Dominicans effected a correction in the Scriptures, others have come and arranged a new correction, which contains more than the half of one Bible, some of whose flowers when collected are scarcely contained in so great a space as that required for the New Testament. And because they see that they have erred in the old correction, they have now made a statute that no one shall adhere to it, and yet the second correction on account of its dreadful length has along with many truths incomparably more false statements than the first correction, as your Glory will be able clearly to perceive when the proof in particular shall be presented to your authority.

Chapter V

What I have shown in general can be shown in examples. For corruption of the text takes place without limit by the addition, substraction, alteration, union, division of statement, word, syllable, letter, diphthong, mark of breathing, so that not only the letter but the literal and spiritual sense is changed. The faults are found not only in one statement, but in many, nay, they affect many folios. I shall now give one or two examples of each of these faults. For many prologues are placed in the text superfluously, since they are not prologues of the text giving an explanation of the translation of the books to which they are prefixed; but they are either letters sent to friends, like the letter of Jerome to Paul, which in the caption of the Bible is reckoned a prologue and is commonly so called, and yet it is contained in the book of Jerome's epistles; or they are prologues to commentaries on originals not to the text, like the one prefixed to the book of Ecclesiastes. For without doubt it is the prologue of the original itself and this is clear from its purport. And the same is true of many others which are not in ancient Bibles. Of a superfluous statement there is an example in Deuteronomy, "Cursed be he that sleepeth with the wife of his neighbor, and the people shall say Amen"; since neither the ancient codices nor the Hebrew or Greek have this verse. Of a superfluous word there is a horrible and dreadful example

in the eighth chapter of Genesis, when the statement is made that the raven did not return to the ark. For the Hebrew has the affirmative and all the Jews hold this view: and the ancient Bibles have the affirmative, and Jerome in the original. The negative was accepted a short time after from another translation, doubtless that of the Seventy, whose falseness Jerome shows in numberless places, and which since the time of Isidore and before has been discredited. For he himself states in his book on the Offices that as a general rule all Latin Churches use the translation of Jerome, because it is more truthful in the expression of thought and clearer in phraseology, with the exception that owing to the frequent practice of singing in the Church the translation of the Psalter following the Septuagint has remained. But before the Roman Church ordered this translation to be used everywhere, Augustine and others and Jerome himself in his time used, as did the Church, the ancient translation. Therefore when Augustine quotes this text in the sixteenth book of the City of God and expounds it, he had to use the translation in common use and received among the Latins, nor could he do otherwise. Since, indeed, a glossarist a hundred years later placed glosses on the text, he accepted the authority of Augustine from the City of God, and placed the negative beside the text, but he did not alter the text nor did he insert the negative. Modern scribes, paying no attention to the difference in translations, nor considering what translation they were using, have inserted the negative on their own authority and in the first instance some one noted among the rest did this. In this way a terrible error was spread abroad, since a contradiction is given for its opposite. But we see in philosophy that there is sometimes a double or triple translation of the same book, and one translation has what is different from another or sometimes what is contrary. But there is no one who has ventured to mix one translation with another.

The error found in ecclesiastical books of reading a negative was introduced by those interested in these books from a corruption of the original. As regards the change of a syllable, and consequently of the whole word, there is a strange example in the case of Joseph, who is said in the common version to have been sold for thirty pieces of silver on account of the example of the Lord. But according to the ancient codices, and the Hebrew,

Greek, Arabic, and Jerome in the original, and Josephus in the first book on Antiquities, the reading should be twenty, not thirty. Likewise in the Psalter by a change of syllable the whole word is changed with great error, when it reads, "My soul has thirsted for God the living fountain." For since the Church uses the translation of the Seventy in the Psalter alone, Jerome has corrected this translation twice, and has placed *fortem* where we put *fontem* through an error due to the similarity of the words, and because in the preceding verse mention is made of fountain, and because thirst corresponds to the idea of water. But as I have said, Jerome has corrected it to *fortem;* and this is the reading in the Hebrew and the Greek, and in Jerome's own translation which he made from the Hebrew. This is also the reading in all ancient Bibles, and in the ancient Psalters of the monasteries. For I have examined this matter carefully, and there is assuredly here merely a very despicable error due to the similarity mentioned.

As regards the change of a letter this a notable example in the first chapter of Judges where we find the words *in monte Hares. Hares* is interpreted by *testateo* [of tile, or brick], with the penult letter e not i ; but it is generally taken as *testatio* with an i, so that it would be a nominative case and formed like *testificatio* from *teste;* but it must be the ablative derived from *testa,* for in all ancient books it is *testateo* with an e, both in Greek and Hebrew, when *Hares* occurs. Jerome has translated it by tile, or by something derived from tile, or by something like it, as brick or dryness. For *Hares* in Hebrew signifies tile or some one of the aforesaid meanings in Latin. Hence Jerome in the sixth book on Isaiah expounding this word in the sixteenth chapter, "To those who rejoice over walls of baked brick," says, "*Hares* signifies tile or baked brick," and in the eighth book, expounding this word in the twenty-fourth chapter of Isaiah, "The moon grows red," he says that *Hares* signifies tile or dryness. The fact that in the thirty-first and thirty-second chapters of Jeremiah the names *Ananeel* and *Anameel* are erroneously confounded, so that the letters m and n are placed without distinction in the penult, is a great error in the change of one letter. For Jerome says in the original that *Ananeel* written with an n is a tower, with an

m is the son of Sellum, cousin on the father's side of Jeremiah; and it is so found in the Hebrew.

As regards the diphthong, there is that example in the sixteenth chapter of Proverbs, *lapides sacculi* [stones of the bag] according to the Hebrew and the Greek and ancient writers, although it is commonly given as *seculi* without a diphthong for *saeculi* in some not very ancient writers. The error in this instance secured a foothold because this noun *seculum* ought to be written with the diphthong, and it is thus correctly written in all ancient books in every instance. Since there is only a slight difference between c and e, some of the old writers of our own times were deceived and changed the first c into an e, thus writing *saeculi;* and since modern writers do not write it with a diphthong, they have therefore retained this noun *seculum* written in their own way, and have neglected the noun *sacculum,* which has the correct letter.

As to the mark of breathing there is an example in the First Epistle to the Thessalonians, when we read, *"Ad tempus ore,"* so that *ore* would be the ablative case of this noun *os oris,* and not the genitive of this noun *hora horae.* It is written therefore in the ablative case, and is glossed, not by a sacred writer, but by the Master of Sentences, who glossed the Epistles; but just as he has failed in many instances elsewhere owing to his ignorance of Greek, so has he failed here, since without question in Greek from which it was taken the genitive case of this noun *hora* is found to be *horas* and is aspirated in both Greek and Latin. But *os oris* is not aspirated, for this noun *hora* is Greek, although it is declined in the Latin manner like *domina.* But Greek declines it thus, *hora, horas, hora, horan, hora.* Hence the nominative, dative, and vocative are alike, the accusative in *an,* genitive in *as;* ablative the Greeks do not have. And this word in the Greek is *horas,* as I have read with care, and any one can prove it who knows Greek, and the aspirate is found in ancient writers.

I have desired to offer these examples, that some proof may be given by way of hint of the necessity of knowing foreign languages, owing to the corruption of the Latin text both in theology and in philosophy. But the method followed in a clear proof, and particularly in one dealing with all the corruptions of the Bible, is postponed to another time, owing to the great-

ness of the matter, which can, when you wish so to order, be presented to your Holiness, but not by me adequately but rather by another; the importance of which I shall explain to you in what follows.

Chapter VI

The seventh reason why it is necessary that the Latins should know languages is particularly false interpretation, although the text be absolutely correct. For in both theology and philosophy interpretations are necessary, especially so in the sacred text and in the text of medicine and in that of the secret sciences, which are too obscure owing to the ignorance of interpretations. For physicians are confused because of the bad interpretations which they call synonyma. For it is not possible for them to use the established remedies owing to the error in these synonyma, and therefore there is no end of peril in their hands. It is the same with the sacred text; for the chief difficulty in knowing it is due to the variety and obscurity of an infinite number of interpretations, as is clear in a familiar example which will serve for others without number. For the common interpretation of the name Israel for the patriarch is the "man beholding God," and this continued in use up to the time of Jerome, and even up to the time that his translation and exposition were ordered to be used in all the churches. But he himself says in the original, although they are men of great influence, who have interpreted Israel as the "man beholding God," and although their shadow oppresses us, yet we agree with God rather, or the angel who gave this name, than with the authority of a man of secular eloquence. He accordingly proves his assertion in admirable fashion. For those who interpreted it thus believed that this word has the same signification united as when divided, like *respublica* with us. But this is not in general true, nay, there is an instance of it in many cases in every tongue. Now in Hebrew *is* is man, *ra* beholding, *el* God, and therefore they believed that this name of the patriarch must be divided into those three words. But Jerome proves this interpretation false by many arguments; for four arguments can be drawn from his statements based on the word, and four or five

based on the fact. For in those three words there are other letters and more in number than in the name of the patriarch and they are found in a different order and syllabication. Therefore from this triple argument taken from the letters Jerome concludes that there cannot be the same signification in this case and in that; since the reason for the same signification rests on the identity of the words. But it is clear that the word and the letters differ too much, since in the name of the patriarch there are these five letters in order, *iod, sin, res, aleph, lamet,* as the Hebrew thus arranged shows יִשְׂרָאֵל, Iserael. But in this triple word these eight letters have the following order, *aleph, iod, sin, res, aleph, he, aleph, lamet,* as the Hebrew shows.

is	ra	el
אִישׁ	רַאֲה	אֵל

A fourth argument can be drawn from the pronunciation. For, as the points show, the proper name does not retain in the Hebrew the exact sound of those three words, but it has a greater sound, because Iserael is pronounced in four syllables; but the three words are limited in pronunciation to only three syllables, so that we say *is, ra, el;* since one point under a letter has the sound of *i,* two points that of *e,* and a line with a point beneath it has the sound of *a.* But according to Jerome stronger arguments are drawn from the sense of the word. For it is shown by the text, Hebrew, Greek, and Latin, and by Josephus that Israel ought not to be called "the man beholding God," but "chief or prince with God," since in Hebrew the literal sense is as follows, "And God said, thy name shall be called no more Jacob, but Israel, since if thou wast a chief or prince with God, thou shall be able to be one with men also." Therefore Jerome says that the sense is, "Thy name shall not be supplanter, that is Jacob, but thy name shall be prince with God, that is Israel. For since I am a prince, so shalt thou be called a prince who wast able to wrestle with me. If moreover thou wast able to strive with me, how much more with men, that is with Esau, whom thou shouldst not fear." And the Hebrew itself shows this here written in this way.

Jacob	non	dixit et
iaecove	lo	iomer va
יַעְקֹב	לא	וַיֹּאמֶר

nomen tuum	amodo	dicetur
simecha	oze	ieamer
שִׁמְךָ	עוֹד	יֵאָמֵר

quoniam	Israel	si	quoniam
ki	icerael	im	ki
כִּי	יִשְׂרָאֵל	אִם	כִּי

Deo	simul	principatus
elohim	im	saritha
אֱלֹהִים	עִם	שָׂרִיתָ

poteris et	hominibus	simul et
tuchal va	enasime	im ve
וַתּוּכָל	אֲנָשִׁים	וְעִם

The Greek text has the verse as follows: "Since thou didst prevail with God, with men also shalt thou be strong." And the Latin has: "Since thou wast strong against God, how much more wilt thou prevail against men." Josephus in the first book of the Antiquities says that he was called Israel because he withstood an angel. Therefore all these expressions, namely, to be a prince with God, and to prevail, and to be strong, and to stand against or with God, are reduced to the same meaning, as is evident, but interpreted by different words, no one of which in virtue of its meaning can have the signification of beholding God. Therefore the true interpretation is "a prince with God." And in addition Jerome confirms this by an argument from derivation. For Sarith, which is derived from the name Israel, means prince, as he states. Whence also Sara the wife of Abraham is called princess, just as Jerome says on the

seventeenth chapter of Genesis. Wherefore if people in general or some ancient writers, like Eusebius of Caesarea in his book of Hebrew Names, which Jerome translated into Latin, and others, abusing a well-known interpretation, say that Israel is interpreted as the "man beholding God," we may say with Jerome: "The interpretation of Israel as *the man beholding* God, given in the book of Names and generally accepted seems to be more forced than true." If, therefore, any one should argue that his authorities for the statement that the true meaning of this word Israel is "the man beholding God" are Eusebius in the book of Names, translated by Jerome into Latin, and Ambrose and other perchance sacred writers, we must answer that they spoke following the common exposition, before the truth was disclosed, which later the blessed Jerome revealed to the Latins by a true and correct interpretation; even as it is contained in his books, and appears also in the gloss. If, therefore, it be said that it is the custom of modern theologians to take this interpretation, the proper answer is indicated in the statements given above of Augustine, Cyprian, Isidore, and others. For according to them custom should yield to truth when revealed, in order that giving up the error of the throng we may follow the truth; and that which has come from ignorance ought not to be alleged in proof, as is being done in the matter under discussion. And above all we should not oppose a sacred author and teacher when he brings forward in support of his position convincing reasons and authorities. Furthermore, for the assurance of all, any one can consult Hebrew scholars, and he will find the judgment of the blessed Jerome ratified and unshaken. There is the greatest need of remedies against false statement in these interpretations on account of the form of Hebrew speech. For in the common interpretations, which are placed at the end of the Bible, there are infinite occasions for errors because a word is reckoned according to the Latin standard which has many forms in Hebrew. And there is the greater error because to such a word various interpretations are given, as though they belonged to the same Hebrew word, whereas each belongs to a different one, because a Hebrew word written by us without due consideration in a single way has different letters in Hebrew and different ways of writing, according to which it receives different meanings. Jerome gives an example

of this in his epistle on Mansions.* For *or,* if it is written with *aleph,* means light; if with *ain,* skin; with *heth,* hole; with *he,* mountain. He says, therefore, that in the twentieth chapter of Numbers some have interpreted it in these four ways; but he eliminates three of these because in the Hebrew this word is written with the letter *he,* and therefore in this place has the meaning of mountain only. But in preaching and reading theologians have recourse to all four expositions in this word; and so also in other words because of their various interpretations.

The last scientific reason for the need of other languages is the fact that Latin grammar was formed from Greek and Hebrew. For we received our letters from the Greeks, as Priscianus shows, and the whole method of treating the parts of speech Priscianus received from the Greeks, as he bears witness, and he mixes Greek freely in all his books. The words themselves of the Latin tongue, both theological and philosophical, were brought in for the most part from other languages; of which words the Latins suspect some to be from another tongue, while others they do not consider as descending from such a source. Many, in fact, are reckoned as wholly Latin when in reality they are Greek or Hebrew, Arabic or Chaldean, in which words error is frequent on the part of the Latins in their pronunciation, writing, and meaning. For it is no small impropriety to make mistakes in words; because as a consequence a man errs in his statements, then in his arguments, and at length in what he reckons as conclusions. For Aristotle says, "Those who are ignorant of the meaning of words often reason falsely." Boetius places the first and principal foundation of learning in an exact and complete knowledge of terms, as he shows in his work Disciplina Scholarium; and we experience this in each of the sciences. For the principal difficulty in a science and its usefulness are found in knowing how to understand the words employed in the science, and to express them in a wise manner and without error. When a man has advanced thus far, he can accomplish the rest by himself without further teaching if he be diligent in study. For the texts of the sciences are plain to him after he has learned how properly and correctly to understand and interpret; and without difficulty he can understand any scientist, and can confer ably with any one, and be instructed,

* *I.e.,* the forty-two stopping-places of the Children of Israel.

if necessary, by any one. Aristotle says in the first book of the Heavens and the World, "A small error in fundamentals is a great one in what is derived from them." For he who makes an error in the foundation of necessity piles up his whole building on the error.

We judge, therefore, that our language is composed of Latin words and contains few words from other tongues, whereas words in common use are from foreign tongues, as *domus, scyphus, clericus, laicus, diabolus, Sathanas, ego, pater, mater, ambo, leo, bos, ager, malum,* and a host of others which with difficulty could be contained in a large volume; especially so if the words used in the different sciences were examined, particularly theology and medicine. Nothing would be more useful than such a volume, if it furnished all the words correctly written and properly pronounced, together with a trustworthy derivation and an accurate interpretation. But as it is we make countless mistakes in these four particulars to the great detriment of all learning, as we can perceive from a few examples. For we do not consider the order of languages, nor the fact that an earlier language does not receive the interpretation of a later one, nor that different languages in that in which they are different do not mutually expound themselves, as Jerome says on the seventeenth chapter of Genesis, "No one in naming a thing in one language takes the etymology of the word from another." Servius also makes this statement in the commentaries on Vergil. Above all, an earlier language cannot have its origin in a later one, as is clear to every reasonable man. Hence Greek does not spring from Latin, nor Hebrew from Greek. Therefore Hebrew must not take its etymology from Greek, nor Greek from Latin. Hence Jerome says in the place mentioned, replying to certain objectors, "*Sarra* ought not to have an explanation from the Greek but from the Hebrew, since it is a Hebrew word." Servius says that *Lenaeus* is derived from *lenos,* wine vat, not from *lenio,* because a Greek noun cannot have a Latin etymology. But we commonly and without distinction disregard this rule. For we say that *amen,* although it is Hebrew, is derived from *a,* the Greek prefix, meaning without, and *mene* a Greek word meaning defection. And although *Parasceve* is Greek, we say that it is derived from *paro, paras,* and *coena, coenae,* which are Latin words.

The statement is also made that *dogma* is derived from *doceo,* and that *jubileum* comes from *jubilo,* and similarly in regard to a host of other words, all of which derivations are false. Not only the rank and file of the Latins but the authorities err in these matters; as, for example, Hugutio and his followers, who think that *jubileum* is derived from *jubilo,* whereas *jubileum* must be Hebrew and *jubilus* is Latin. But the word should not be written *jubileum* with the letter *i* in the second syllable as in *jubilo;* but it should have the letter *e* and be written *jubeleus,* as Isidore and Papias maintain, and all ancient books so have it. For it is derived from *jobel,* which is Hebrew.

Chapter VII

Since, moreover, we know that many words in use among Latins must be interpreted through other tongues, we believe, owing to our familiarity with this fact, that far more words than the fact warrants derive their etymology from a foreign source. For only those words having a Greek and a Hebrew origin and derivation ought to be interpreted by those languages. For words of pure Latin origin can have no exposition except by means of Latin words. For the pure Latin is altogether different from every other tongue, and therefore does not have an interpretation from a foreign source. But the Latins pay no attention to this fact, nay, without distinction they interpret pure Latin words by other languages, like the words derived from the Greeks. Hence in many ways they interpret in Greek this word *caelum,* which is pure Latin, stating that *caelum* is equivalent to *casa helios,* that is, house of the sun, for the sun is called *helios.* But their statement is inconsistent and false. For since *helios* is in the nominative case and not in the genitive *casa helios* is inconsistent; for they should say *casa heliu,* because *heliu* is in the genitive case. Secondly, the statement is false; for as Varro, most learned of the Latins, to quote the words of sacred writers and philosophers, teaches us, and Pliny confirms his statement in the prologue to his Natural Philosophy, that *caelum* is derived from *caclo, caelas,* that is, *sculpo-pis,* because it is carved and adorned with stars, which is manifest from the rule for writing words. For *caelo-las* for

sculpo-pis is written with the diphthong *ae* in all ancient books; and likewise this noun *caelum* in all the ancient codices is written with this same diphthong, and is therefore derived from *caelo,* which is the same as *sculpo.* Hence it follows that it is not derived from *celo, celas,* which is a synonym for *occulto-tas,* as those claim who give this noun a Latin etymology, stating that it is so called because it is hidden and far removed from us. These interpreters like those preceding have been deceived by a wretched error. Likewise this word *ave,* which is pure Latin, they expound in Greek, stating that it is formed from *a,* meaning without, and *ue,* as though it were *sine ue.* But this cannot be since this word is not taken from the Greek word of cognate signification. For *chere* in Greek signifies *ave* in Latin, but these two words do not agree, and therefore much less will it draw its exposition from other sources. This then is one way in which mistakes are made in an almost countless number of Latin words.

Chapter VIII

Another form of error is due to the fact that we do not pay attention to the many different ways of writing in Greek words, and that words very similar in sound are distinguished in meaning. The Greeks have three forms of *i,* two of *o* and two of *t, p,* and *c;* they have eleven diphthongs and many other ways of showing the variation of their words in meaning. For *cenos,* meaning empty, from which comes *cenodoxia,* that is, vanity, of which we read in the seventh chapter of Deuteronomy, is written with a short *e;* and *cenos,* that is, new, from which comes *encenia,* that is, innovations like a new feast and dedications of churches, of which we read in the tenth chapter of John, is written with the diphthong *ae,* thus, *caenos.* But *cenos,* that is, common, from which come *cenobium* and *epicenon,* is written with the diphthong *oi,* although the Latin has an *e,* but it should have *i,* so as to read *cinos.* Hence from this word is formed *cinomia,* which is, according to Jerome in his correction of the Psalter, the common fly or fly of every kind. Hence Papias says that it is written with the diphthong in the first syllable thus, *coinomia,* and this is proved from the Greek

Psalter. Also the word *cynos,* dog, when it is written with the Greek *y,* whence *cynomia,* that is, dog fly, of which we read in the eighth chapter of Exodus. The word *xenos* with *x* means foreign, from which comes *xenia,* meaning presents or gifts, of which we read in the first book of Maccabees and in the twentieth chapter of Ecclesiasticus. Also *schenos* with *sch* is a rope, from which is formed *schenobates,* one who walks on a rope or over a rope; and *scena* means shade or tent, from which is formed *scenopegia,* that is, setting up a tent or the art of tent-making, at which Paul the Apostle labored. Since, therefore, the derivatives and compounds of those words differ so in their meanings, although they are similar in expression and sound, like the words from which they are derived, it is clear that he cannot escape error in the literal sense who disregards the written form of words of this kind. Hence many famous living expositors have been at times deceived, such as Rabanus, who on the eighteenth chapter of the Acts says that the *schenofactoria ars* [art of tent-making] teaches how to make ropes, because he thought that *schenos* meaning rope is the word from which the noun is derived. But Bede teaches to the contrary, holding that it is derived from *scena* [tent]. And this is shown clearly in the writing of the word, namely, in the eighteenth chapter of the Acts, in the Greek text the word is written with the first syllable lacking the aspirate, and with the vowel called *ita,* that is long *i,* and is so written *scena* for tent; but *schenos,* meaning rope, is written with the diphthong *oe,* and with the aspirate. And thus there is a contention among the doctors about *cynomia* and the other words mentioned. Hence as regards *xenia* the majority believes that it does not exist and corrects it in the sacred text into *exenia.* But in the ancient Bibles it is not so written, nor in Greek, nor can the word be so formed according to Greek grammar, because it would require the placing there of the Greek preposition *ex,* which is impossible, since the word begins with a consonant, as is clear according to the grammar of the Greeks. In this way error arises in almost countless words.

Chapter IX

The third form of error is due to the fact that we do not observe as we should that while the Latins have much in common with the Greeks they yet differ from them in some particulars. For since Priscianus states the fact and all the Latins are aware that the name of a tree is in the feminine gender and terminates in *us,* and the name of a fruit is neuter and terminates in *um,* as *pomus, pomum; pirus, pirum,* etc., they think that this principle holds good in regard to all words in use among the Latins, like the words *malum* and *amigdalum* and others. For the Latin rule is to be understood as applying only to Latin words, not to Greek words nor to others. That this is a fact is clear in the first place because the Latin gives its rules concerning Latin words, and it is not within its province to form rules for other languages; in the second place, Priscianus says that every Greek word passing into Latin retains its own gender that it had in Greek; and therefore since the word *malum* for tree is Greek and of neuter gender, it will remain so in Latin; and therefore whether it has the meaning of fruit or of tree it will be of the same gender and of the same termination. And this is proved by Vergil, who says in the Georgics *mala insita;* trees are ingrafted, not fruits; and in regard to this Servius the commentator, who was greater than Priscianus, for he frequently quotes the authority of Servius, says that this rule, "All names of trees are feminine," is to be understood of Latin, not of Greek nouns. The word *malum,* moreover, is Greek, as he states; and it is certain that it is Greek, although in accordance with Latin custom pronounced somewhat differently, since no word in Greek ends in the letter m, but in n; and Latin is accustomed to terminate its own words in m, as *scamnum, lignum, pomum,* and the like. Likewise the Latin often changes a vowel in a Greek word, as where the Greek says *grammaticos* the Latin has *grammaticus,* and so in many instances. This is the case here, for the Greek says *melon* for tree and fruit; the Latin changes the e into a, and n into m, and says *malum.* But this change does not alter the word as regards the nature and root; because it was taken from Greek, although altered in pronunciation, and to this fact all authorities bear witness. But throughout Latin texts in ancient books on theology and phi-

losophy we always find the word *malum* for tree. For in the first chapter of Joel *malum* for tree is generally found in all Bibles; and up to the present time the correctors have let it pass in the new Bibles, and in all the ancient Bibles it is likewise found in the fourth chapter of Canticles, where we read, "As the appletree among the trees of the wood"; and so Bede expounds it in the original. And in the twelfth chapter of Ecclesiastes is the word *amigdalum* in all ancient Bibles; and *malogranatum* in the singular and *malogranata* in the plural are found in the books of the law, which would not happen if *malum* were not of the neuter gender. Therefore these words are changed in accordance with the form of Latin words inconsistently, and it is particularly strange that in one passage the correctors allow the ancient letter to remain, and in another passage rub it out, a procedure altogether opposed to reason.

Chapter X

Likewise in the pronunciation of the Greek letters there is a great deal of error because the Latins wish to keep their own manner of pronunciation in the Greek words. And in this there is a very grave error; since all the Latin poets and all the ancient Latins pronounced according to the primitive custom. But we of modern times have violated this rule in many ways contrary to the practice of all the ancient Latins and their authors. For example, when Priscianus says that possessive adjectives ending in *nus* are long and are accented on the penult, as *Latinus, bovinus, equinus,* and the like, the rule is to be understood of Latin words, not of Greek, for certain reasons previously touched upon. And therefore since *adamantinum, byssinum, crystallinum, hyacinthinum, bombycinum, onychinum, amethystinum, smaragdinum,* and the like are Greek, they should be short in the penult, as the Greeks make them. Moreover, these are not possessives; for there are only two terminations for possessives in Greek, namely in *cos,* as *grammaticos,* and in *os,* as *uranios,* that is, belonging to heaven. But all the Latin poets make the penult short, and it is not a poetic license, because they all do it in every instance. For what happens rarely and for a reason is to be ascribed to poetic license, but

not that which is of common and constant occurrence. Whence Juvenal's *Amethystina convenit illi.* And he likewise says *grandia tolluntur crystallina,* with short penult. Persius also shortens the penult, saying *hyacinthina laena* at the end of the verse, and so do all the poets without exception. Therefore it is not a case of poetic license, but it happens in accordance with natural law. And since in the seventeenth chapter of the second book of Kings the words occur *quasi siccaret ptisanas,* a famous exposition of the words of the Bible, to which all give adherence, tries to prove that the middle syllable of *ptisanas* is long; and the author of this exposition defends himself by a verse of Horace, which reads: *Tu cessas agedum sume hoc ptisanarium oryzae.* But it is an error, for, as can be proved by all authors, only one syllable is elided at the end of a word in meter; and therefore this should be scanned, *hoc ptisanari oryzae,* making the syllable *sa* short and the syllable *na* long. This is clear for another reason, for in all derivatives *a* before *rium* is long, as *contrarium, armarium,* and numberless others of this kind. This rule is observed in the scansion above, but not in the one generally given, *ptisanar oryzae,* requiring the elision of two syllables, because in the latter this syllable *na* is short, as is evident. Therefore of necessity the middle syllable of this word *ptisana* is short and must be grave in accent. Moreover, there is an error in the writing of the word. For in the new Bibles it is given as *tipsanas,* which has no meaning; and therefore the *p* should be placed before the *t,* as in the name of Ptolemy and in many other words. This kind of error occurs over and over again in other words; and we have made such violent changes in the correct rules of accents that there is no help to be found in our teachers; since custom forces all to pronounce badly, as is made clear by a single example in place of the thousands that might be cited. *Butyrum* has a short penult in Latin authors. Hence Statius says in his Achilleid,

Lac tenerum cum melle bibit, butyrumque comedit.

And Macer in his books on Herbs has,

Cum butyro modicoque oleo decocta tumorem.

The Greek also has it short, and the component parts of the word require it. For it is formed from *tyros* and *bos,* and *tyros* is short in the first syllable. The word means milk-food which

comes from the cow. But far greater mistakes are made by many, and there is ignorance of the truth in regard to accents on the part of all. But a broader consideration of this matter is required than the limits of the present production permit.

Chapter XI

Since I have now shown how a knowledge of languages is necessary to the Latins owing to the pure zeal for knowledge, I now wish to state why this should be secured because of the wisdom established for the Church of God, and the commonwealth of the faithful, and the conversion of unbelievers, and the repression of those who cannot be converted. For in four ways is this knowledge necessary to the Church, first on account of the divine Office, because Greek, Hebrew, and Chaldean words are used in the Office, just as they are in Scripture; and we hear many words, which the Scripture does not use, like *agios, atheos, athanatos, iskiros, imas, eleyson, kyrie,* and the like. When, therefore, we are ignorant of the writing and the correct pronunciation and the sense, we shall miss much of truth and devotion in our singing; for we speak like the magpie and the parrot and other brute creatures which imitate human voices, but neither pronounce correctly nor understand what is said. For since we say *alleluia* many times in a year, it is very proper and right that all those who sing throughout the whole Church should know that they are two words, namely *allelu* and *ia.* For *allelu* signifies the same as *laudate* and *ia* denotes *Dominus,* since it is one of the ten names of God, as Jerome writes to Marcella; and in particular it signifies the invisible one, and God is the most invisible of all. Hence it does not designate any one at all who is invisible, but it designates God. In every Mass we say *Osanna,* a word composed of two elements one correct and the other incorrect. For, as Jerome says to Pope Damasus, *osi* is the same as *salvifica,* and *anna* is the interjection of one praying, the first syllable in this case being written with *aleph.* Whence the meaning is the same as *salva deprecor* [save, I pray]. In other cases the first syllable is written with the letter *he* and then denotes a conjunction which the Latin language does not have. And when we salute the glorious

Virgin saying, *Ave Maria gratia plena, Dominus tecum,* it is very essential for a true and devout understanding that each educated person should know the meaning of the word, and especially so since many thinking that they know make many errors in this matter. There is a Syrian word, *Maron,* signifying Master, from which *Maria* comes; and it is the same as *dominatrix* [mistress], as Jerome says in his interpretations. This meaning especially befits the most blessed Virgin, who is mistress over all the uncleanness of sin that she may drive it from us, and over all diabolic guile and wickedness, because she is the terror of sin and of the demons, like the ordered line of battle of a camp; and not she only, but all who really put their trust in her. This interpretation is most correct and without sophistry. Jerome, however, says in his interpretations that many have thought that *Maria* should be interpreted "she that illumines" or "myrrh of the sea." He does not accept this meaning but says that it should be "star of the sea" or "bitter sea" according to the Hebrew interpretation. And she is rightly called Star of the Sea, that she may direct us to a port of safety; also Bitter Sea, because she lived in absolute poverty and temporal bitterness in this world, and at length a sword passed through her soul in the death of her Son, so that she is an example to us of all patience and a comforter in every adversity in this world. It is necessary for us therefore in all our psalm-singing and prayers to know how rightly to pronounce and understand, and that as regards the proper meaning of words we should know how to frame our petitions devoutly, in order that we may obtain by the goodness of God and the saints and by the merits of the Church what we ask for rightly and devoutly. But we cannot do this without the knowledge of the words in another tongue; and therefore it is very expedient and necessary that we should have this knowledge. The second reason is because a knowledge of languages is necessary to the Church of God on account of the sacraments and consecrations. For intention is necessary to a sacrament, as theologians know. Understanding and knowledge of the thing to be done precede intention. And therefore in every way it would be expedient for the Church that her priests and prelates should know how correctly to pronounce and understand all the words of the

Masses and sacraments and consecrations; just as in the beginning the holy and high pontiff, and all the sainted fathers and founders of ecclesiastical orders decided and knew how the mysteries of God consist in words and their meanings. Whence it is not only proper, but expedient and necessary that those who minister the sacraments, beginning with the first exorcisms and purifications and so passing on through baptism and all the sacraments, should know the correct pronunciation and the required sense, to the end that no sacrament may be impaired. But lately throughout the universal Church countless numbers pronounce the words instituted by the Church and do not know what they are saying, nor do they keep the correct pronunciation of the words. This cannot happen without injury to the sacrament. Would that the effect of the sacrament may have full efficacy! And since the Church established these formularies with definite knowledge and all the ancient fathers knew the correct pronunciation and the sense of the words as befitted the sacraments, we have no excuse; but our ignorance is a base and vile one to be excused by no subterfuge. When in the consecrations of Churches letters of another language according to the order of the alphabet are made with the point of the pastoral staff, it is certain that very few make the letters required, as they were originally determined on by the sainted fathers and by the Church, owing to ignorance of the characters of the other language and in particular an error is made in this manner that three figures are made, which in no way ought to be written in the Greek alphabet. For without doubt the figures which are called episemon ϛ, koppa, and the character ϡ are not from the alphabet of the Greeks, nor did the Greeks ever insert them in the order of their letters; but they are figures and marks of numbers. Modern Latins, however, do not bear in mind that the Greeks number with the letters of the alphabet, and that they have inserted to complete their numeration the three figures mentioned above, namely, ϛ ϟ ϡ. But they do this when they count, not when they use the figures as letters and in writing. Hence in writing they never use these three characters, nor do they place them in the order of the alphabet. But the Church determined that letters alone of the alphabet should be written, in the consecration of the Church, and decided to use letters, not the signs of numbers. Therefore

it is most improper that erroneous writing of this kind should be practiced throughout the universal Church.

It is a wretched thing that these words $\overline{\text{I H C}}$. $\overline{\text{X P C}}$. are written in Greek letters, and people think that they are Latin, or are in ignorance of the manner in which they are Greek. For without doubt in this word $\overline{\text{I H C}}$. the first letter is *iota,* equivalent to our *j;* the second is *ita,* equivalent to *e* long; the third is *sima,* equivalent to our *s.* And in this word $\overline{\text{X P C}}$. the first is *chi,* equivalent to *ch* aspirated; the second is *ro,* equivalent to our *r;* the third is *sima.*

There is a third reason for the necessity to the Church of God of a knowledge of languages. For many Greeks, Chaldeans, Armenians, Syrians, Arabs, and nations of other tongues are subject to the Church of the Latins, with whom the Church has to arrange many matters, and to give them various directions. But these matters cannot be handled in the right and advantageous way that they should be, unless the Latins have a knowledge of their languages. Of this there is proof in the fact that all the nations mentioned waver in faith and morals, and neglect the orders of the Church pertaining to salvation, because a genuine plea is not addressed to them in their mother tongue. Hence everywhere among such nations there are evil Christians, and the Church is not ruled as it should be.

The fourth cause is due to the progress of the whole Church from the beginning to the end of days. For the Lord says, one jot or one tittle shall in no wise pass from the law, till all be fulfilled. And therefore there is an admirable exposition in the book on the meanings of the Scriptures stating how the individual letters of the Hebrew alphabet had significance respecting the ancient people, and how they show the number of centuries through which the state of that race passed as regards the different periods and ages, in accordance with the special powers and potencies of the letters; and then the progress of the Church of the Latins is shown by the virtues of the Latin letters. A similar examination is made of the Greek Church by means of the letters of the Greek alphabet. In a remarkable examination of this kind the periods of time are distinguished as regards the varying conditions of the Church to the very end, and we learn through how many hundreds of years each change happening to the Church in its history will last. If we should

unite to this remarkable examination prophecies and reliable testimonies, we would be able by the grace of God to perceive in advance to our profit those things which the Church shall receive in her prosperity as well as adversity. Therefore nothing would be more useful than an examination in this way of the value of the letters along with other similar examinations. For to secure certainty in such important matters many ways are needed, of which the one at least is not ignoble which employs the letters of the different languages. I cannot sufficiently admire the manner in which this examination was devised, although it may seem to the uninitiated to have a weak basis in the letters of the alphabet, which are the first rudiments of children. But according to the teaching of the Apostle, lesser things are more necessary and are to be accorded greater honor. And as God has chosen the weak to confound the strong, so has supreme power given greater weight to matters which we reckon insignificant than the human mind can grasp. Such is the case in these letters of the three alphabets; whence not without cause the epitaph of the Lord was written in Hebrew, Greek, and Latin, so that we might be taught that the Church redeemed by the cross of Christ must consider the virtues of the threefold alphabet; especially since the Church began among the Hebrews, made progress among the Greeks, and was perfected among the Latins.

Chapter XII

In the second place, a knowledge of languages is very necessary for directing the commonwealth of the Latins for three reasons. One is the sharing in utilities necessary in commerce and in business, without which the Latins cannot exist, because medicines and all precious things are received from other nations, and hence arises great loss to the Latins, and fraud without limit is practiced on them, because they are ignorant of foreign tongues, however much they may talk through interpreters; for rarely do interpreters suffice for full understanding, and more rarely are they found faithful. A second reason is the securing of justice. For countless injuries are done the Latins by the people of other nations, the sufferers being the

clergy as well as the laity, members of religious orders, and friars of the Dominicans and Franciscans who travel owing to the varied interests of the Latins. But owing to their ignorance of languages they cannot plead their cases before judges nor do they secure justice. The third reason is the securing of peace among the princes of other nations and among the Latins that wars may cease. For when formal messages along with letters and documents are drawn up in the respective languages of both sides, very often matters which have been set on foot with great labor and expense come to naught owing to ignorance of a foreign tongue. And not only is it harmful, but very embarrassing when among all the learned men of the Latins prelates and princes do not find a single one who knows how to interpret a letter of Arabic or Greek nor to reply to a message, as is sometimes the case. For example, I learned that Soldanus of Babylonia wrote to my lord, the present king of France, and there was not found in the whole learned body in Paris nor in the whole kingdom of France a man who knew how satisfactorily to explain a letter nor to make the necessary reply to the message. And the lord king marveled greatly at such dense ignorance, and he was very much displeased with the clergy because he found them so ignorant.

Chapter XIII

In the third place, the knowledge of languages is necessary to the Latins for the conversion of unbelievers. For in the hands of the Latins rests the power to convert. And for this reason Jews without number perish among us because no one knows how to preach to them nor to interpret the Scriptures in their tongue, nor to confer with them nor to dispute as to the literal sense, because they have both the true letter and their own ancient expositions according to ————* and of other men of wisdom as much as the literal exposition requires, and in general as much as it requires for the spiritual sense. For the text everywhere sounds the spiritual note of the Messiah whom we call Christ, even as the Hebrews themselves are not ignorant, because they expect that he will come, but are deceived in re-

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gard to the time of his advent. O unspeakable loss of souls when with ease countless Jews might be converted! What makes the situation as bad as possible is the fact that the foundation of our faith began with them, and we should bear in mind that they are of the seed of the patriarchs and prophets, and, what is more, from their stock the Lord sprang and the glorious Virgin and the Apostles and innumerable sacred authors have descended from them from the beginning of the Church. Then the Greeks and the Rutheni and many other schismatics likewise grow hardened in error because the truth is not preached to them in their tongue; and the Saracens likewise and the Pagans and the Tartars, and the other unbelievers throughout the whole world. Nor does war avail against them, since the Church is sometimes brought to confusion in the wars of Christians, as often happens beyond sea and especially in the last army, namely, that of the king of France, as all the world knows; and if Christians do conquer other lands, there is no one to defend the lands occupied. Nor are unbelievers converted in this way, but they are slain and sent to hell. The survivors of the wars and their sons are angered more and more against the Christian faith because of those wars, and are infinitely removed from the faith of Christ, and are inflamed to do Christians all possible evils. Hence the Saracens for this reason in many parts of the world cannot be converted; and especially is this the case beyond sea and in Prussia and in the lands bordering on Germany, because the Templars and Hospitallers and Teutonic Knights hinder greatly the conversion of unbelievers, owing to the wars that they are always stirring up and because they wish to have complete sway. For there is no doubt but that all nations of unbelievers beyond Germany would have been converted long since but for the violence of the Teutonic Knights, because the race of pagans was frequently ready to receive the faith in peace after preaching. But the Teutonic Knights are unwilling to keep peace, because they wish to subdue those peoples and reduce them to slavery, and with subtile arguments many years ago deceived the Roman Church. The former fact is known, otherwise I should not state the latter. Moreover, the faith did not enter into this world by force of arms but through the simplicity of preaching, as is clear. And we have frequently heard and we are certain that

many, although they were imperfectly acquainted with languages and had weak interpreters, yet made great progress by preaching and converted countless numbers to the Christian faith. Oh, how we should consider this matter and fear lest God may hold the Latins responsible because they are neglecting the languages so that in this way they neglect the preaching of the faith. For Christians are few, and the whole broad world is occupied by unbelievers; and there is no one to show them the truth.

Chapter XIV

The fourth reason, the repression of those who cannot be converted requires rather the way of wisdom than the labor of war. For the unbelievers always return to their own provinces, as we see beyond the sea and this side of it in Prussia and in the lands of the pagans bordering on Germany and everywhere else; because Christians signed with the cross although sometimes victorious, yet after making a foreign expedition return to their own lands, and the natives remain and multiply. The faith should first be preached by men wise in all knowledge, but who are well versed in languages or have excellent and faithful interpreters. When we learn that some race will obstinately resist we should not only get ready a military expedition, but men of learning should assemble who should subjugate not temporarily nor a part of the unbelievers, but all of them who are in proximity to Christians, so that at least the Holy Land with Jerusalem may always remain in the possession of Christians without fear of its loss in the future. And although many secrets of the sciences and of the mighty works in the arts are needed in this matter, of which I shall make mention later in many places, not only on account of those now living, but because of Antichrist and his followers, yet the power of languages and of the different letters must not be despised. For such great virtue can consist in words that no mortal can trace it out. And at this I wish to hint in many ways, because the matter is difficult and subject to great contradiction. For we see that the words of the sacraments have infinite virtue. And we know that at the command and at the words of the

saints from the beginning of the world the laws of nature were changed and elia [*sic*] and other brutes were obedient, and in this way numberless miracles were performed. But the hand of the Lord is not shortened; and we should believe that if on the authority of the Church and with right intention and from desire many true and wise Christians should utter holy words for the propagation of the faith and the destruction of falsehood, that many blessings might result by the grace of God. Oh, how many tyrants and evil men have been confounded at the words of power and convicted rather than through wars! And not only by the words of the saints or of the faithful, but by the words of philosophers have they been so stunned that they were forced to obey the truth. The histories give us definite information in regard to them, and we have seen many of the people who by certain forms of speech have freed many from very great perils. For by two verses containing the names of three Kings of Cologne it happened that ————* I know a man who when a boy found a man in the fields who had fallen in epilepsy, and wrote those verses and placed them around his neck, and immediately he was cured. He had no return of the disease, until long afterwards his wife, wishing to confuse his mind because of her love for a certain cleric, caused him to be stripped, in order that he might lay aside at least during the time of his bath the amulet† from his neck to protect it from the water. On this being done his infirmity at once seized him in the bath. His wife frightened by the miracle again bound on the amulet and he was cured. Who will venture to put an evil interpretation on this and ascribe it to demons, even as some inexperienced and foolish people have ascribed many things to demons, which frequently happened by the grace of God or by the operation of nature and the power of the excellent arts? For how has any one succeeded in proving to me that the incident related was the work of a demon, since the boy had neither the knowledge nor the wish to deceive. And the woman who wished to deceive not only her husband, but herself through fornication in removing the writing, after beholding the miracle was stirred by piety and bound on again the amulet. I prefer to view the matter reverently with a view to the praise of God's

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† Literally, "writing of attestation."

blessings than to condemn with great presumption that which is true. Likewise in Poland and in many districts charms with which to exorcise are made of iron, which is carried in the hands or is walked over. And likewise of the water in which an accused person is placed, a practice of the Church and her priests. The innocent come forth without danger, but the guilty are committed; just as in the old law a woman accused of adultery drinks the consecrated water and was freed if she was innocent, but if guilty her sin was brought to light. But it is certain that the rational soul, which is superior to creatures lower than angels, has in accordance with the rights of its own dignity great power in respect to creatures of lesser worth; just as we see that heavenly bodies, because they are nobler, have power over what is inferior. And any inferior thing that is nobler in virtue can change a thing that is less noble, so that the ignobler things change to their own natures things more noble, as wine intoxicates a man and fire consumes him. But this takes place in so far as wine or fire is nobler; for everything active is nobler than what is passive, as Aristotle states, and it is a fact that, owing to a defect in any creature, one inferior has a certain prerogative which the nobler one lacks. Since therefore the rational soul is without comparison more worthy than the whole animal soul, there is no doubt that it has great power in its works when it is free from spot of sin or when commanded by the grace of God it acts with strong desire and firm intention. But its especial action is the word, and therefore the saints always performed their miracles by pronouncing words. But the rational soul itself knows how to select the time of the chosen constellations for all its works, as the skillful physician selects the proper time for his medicines and blood lettings and other things, as Hippocrates, Galen, Aristotle, Ptolemy, and other authors state. And such is a fact not only in these things, but in all things in which earthly bodies are altered by the virtues of the heavens; and therefore men of wisdom, not only the pure philosophers, but the saints like Moses and others, performed their works under chosen constellations, as I shall show in the proper place, by the locations of which they changed and excited men to many things, without the loss of freedom of the will. Hence they both waged wars advantageously and carried on many great works. And therefore just

as they performed their other wonderful works in their appointed times, so also they formed words, which received great virtue from the heavenly constellation itself, and accordingly they accomplished many things through these words. But these matters will depend on what follows, and therefore I pass them over until we come to the opportune place. If, however, other works can receive virtue from the spotless soul, strong desire, firm intention, and celestial virtue, many sages believe that far more has the word power, which is the principal and the first work of the rational soul, and especially so in the three languages consecrated by the divine mysteries, Hebrew, Greek, and Latin. But let us pause here. For these matters cannot be understood as they should without what follows.

From what therefore has been said in regard to languages, it is evident that the Latins suffer a great loss of knowledge owing to their ignorance of them. Hence in this particular they cannot boast of their knowledge, nay, they are far from glorious and they languish with the loss of knowledge in many fields. Since they have paid no attention to this matter, modern Latins of necessity have been forced to bear the loss along with the censure, from both of which all the sainted doctors, philosophers, and sages remained free.

PART FOUR OF THIS PLEA

In which is shown the power of mathematics in the sciences and in the affairs and occupations of this world.

FIRST DISTINCTION

In three chapters

Chapter I

AFTER making it clear that many famous roots of knowledge depend on the mastery of the languages through which there is an entrance into knowledge on the part of the Latins, I now wish to consider the foundations of this same knowledge as regards the great sciences, in which there is a special power in respect to the other sciences and the affairs of this world. There are four great sciences, without which the other sciences cannot be known nor a knowledge of things secured. If these are known any one can make glorious progress in the power of knowledge without difficulty and labor, not only in human sciences, but in that which is divine. The virtue of each of these sciences will be touched upon not only on account of knowledge itself, but in respect to the other matters aforesaid. Of these sciences the gate and key is mathematics, which the saints discovered at the beginning of the world, as I shall show, and which has always been used by all the saints and sages more than all other sciences. Neglect of this branch now for thirty or forty years has destroyed the whole system of study of the Latins. Since he who is ignorant of this cannot know the other sciences nor the affairs of this world, as I shall prove. And what is worse men ignorant of this do not perceive their own ignorance, and therefore do not seek a remedy. And on the contrary the knowledge of this science prepares the mind and elevates it to a certain knowledge of all things, so that if one learns the roots of knowledge placed about it and rightly applies them to the knowledge of the other sciences and matters, he will then be able to know all that follows without error and doubt, easily and effectually. For without these neither what precedes nor what follows can be known; whence they perfect

what precedes and regulate it, even as the end perfects those things pertaining to it, and they arrange and open the way to what follows. This I now intend to intimate through authority and reason; and in the first place I intend to do so in the human sciences and in the matters of this world, and then in divine knowledge, and lastly according as they are related to the Church and the other three purposes.

Chapter II

In which it is proved by authority that every science requires mathematics.

As regards authority I so proceed. Boetius says in the second prologue to his Arithmetic, "If an inquirer lacks the four parts of mathematics, he has very little ability to discover truth." And again, "Without this theory no one can have a correct insight into truth." And he says also, "I warn the man who spurns these paths of knowledge that he cannot philosophize correctly." And again, "It is clear that whosoever passes these by, has lost the knowledge of all learning." He confirms this by the opinion of all men of weight saying, "Among all the men of influence in the past, who have flourished under the leadership of Pythagoras with a finer mental grasp, it is an evident fact that no one reaches the summit of perfection in philosophical studies, unless he examines the noble quality of such wisdom with the help of the so-called quadrivium." And in particular Ptolemy and Boetius himself are illustrations of this fact. For since there are three essential parts of philosophy, as Aristotle says in the sixth book of the Metaphysics, mathematical, natural, and divine, the mathematical is of no small importance in grasping the knowledge of the other two parts, as Ptolemy teaches in the first chapter of the Almagest, which statement he also explains further in that place. And since the divine part is twofold, as is clear from the first book of the Metaphysics, namely, the first philosophy, which shows that God exists, whose exalted properties it investigates, and civil science, which determines divine worship, and explains many matters concerning God as far as man can receive them. Ptolemy likewise asserts and declares that mathematics is potent

in regard to both of these branches. Hence Boetius asserts at the end of his Arithmetic that the mathematical means are discovered in civil polity. For he says that an arithmetic mean is comparable to a state that is ruled by a few, for this reason, that in its lesser terms is the greater proportion; but he states that there is a harmonic mean in an aristocratic state for the reason that in the greater terms the greater proportionality is found. The geometrical mean is comparable to a democratic state equalized in some manner; for whether in their lesser or greater terms they are composed of an equal proportion of all. For there is among all a certain parity of mean preserving a law of equality in their relations. Aristotle and his expositors teach in the morals in many places that a state cannot be ruled without these means. Concerning these means an exposition will be given with an application to divine truths. Since all the essential parts of philosophy, which are more than forty sciences distinct in their turn, may be reduced to these three, it suffices now that the value of mathematics has been established by the authorities mentioned.

Now the accidental parts of philosophy are grammar and logic. Alpharabius makes it clear in his book on the sciences that grammar and logic cannot be known without mathematics. For although grammar furnishes children with the facts relating to speech and its properties in prose, meter, and rhythm, nevertheless it does so in a puerile way by means of statement and not through causes or reasons. For it is the function of another science to give the reasons for these things, namely, of that science, which must consider fully the nature of tones, and this alone is music, of which there are numerous varieties and parts. For one deals with prose, a second with meter, a third with rhythm, and a fourth with music in singing. And besides these it has more parts. The part dealing with prose teaches the reasons for all elevations of the voice in prose, as regards differences of accents and as regards colons, commas, periods, and the like. The metrical part teaches all the reasons and causes for feet and meters. The part on rhythm teaches about every modulation and sweet relation in rhythms, because all those are certain kinds of singing, although not so treated as in ordinary singing. For it is called "accent" since it is, as it were, song [*accantus*] from *accino, accinis*. Hence these subjects pertain

to music as Cassiodorus teaches in music, and Censorinus in his book on Accent, and so too in those on other topics. Authorities on music bear witness to this fact as well as do their books on that science. And Alpharabius agrees with them in his book on the Division of the Sciences. Therefore grammar depends causatively on music.

In the same way logic. For the purpose of logic is the composition of arguments that stir the active intellect to faith and to a love of virtue and future felicity, as we have already shown, which arguments are handed down in the books of Aristotle on these arguments, as has been stated. But these arguments must have a maximum amount of beauty, so that the mind of man may be drawn to the truths of salvation suddenly and without previous consideration, as we are taught in those books. And Alpharabius especially teaches this in regard to the poetic argument, the statements of which should be sublime and beautiful, and therefore accompanied with notable adornment in prose, meter, and rhythm, as befits place, time, personages, and subject for which the plea is made. And thus Aristotle taught in his book on the Poetic Argument, which Hermannus did not venture to translate into Latin on account of the difficulty of the meters, which he did not understand, as he himself states in the prologue to the commentary of Averroës on that book. And therefore the end of logic depends upon music. But the end of everything is its noblest part in every matter and imposes necessity on what is related to it, as Aristotle states in the second book of the Physics; nor have those things any utility of their own which are naturally formed for the end, except when they are related to their end, as is clear in individual cases. And therefore the whole utility of logic is drawn from the relation of all logical arguments to arguments of this kind, and therefore since they depend on the arguments of music, necessarily logic must depend on the power of music. All these facts are in accordance with the opinion of Alpharabius in his book on the Sciences, and they are likewise clearly stated by Aristotle and Averroës in their books, although these are not used by the Latins. But not only does a knowledge of logic depend on mathematics because of its end, but because of its middle and heart, which is the book of Posterior Analytics, for that book teaches the art of demonstration.

But neither can the fundamental principles of demonstration, nor conclusions, nor the subject as a whole be learned or made clear except in the realm of mathematics, because there alone is there true and forceful demonstration, as all know and as we shall explain later. Therefore of necessity logic depends on mathematics.

What has been said is applicable likewise because of its beginning and not only because of its middle and end. For the book of Categories is the first book of logic according to Aristotle. But it is clear that the category of quantity cannot be known without mathematics. For the knowledge of quantity belongs to mathematics alone. Connected with quantity are the categories of when and where. For when has to do with time, and where arises from place. The category of habit cannot be known without the category of place, as Averroës teaches in the fifth book of the Metaphysics. But the greater part of the category of quality contains the attributes and properties of quantities, because all things that are in the fourth class of quality are called qualities in quantities. And all the attributes of these which are absolutely essential to them are qualities, with which a large part of geometry and arithmetic is concerned, such as straight and curved and other essential qualities of the line, and triangularity and other figures belonging to surface or to a solid body; and the prime and non-factorable in numbers, as Aristotle teaches in the fifth book of the Metaphysics, as well as other essential attributes of numbers. Moreover, whatever is worthy of consideration in the category of relation is the property of quantity, such as proportions and proportionalities, and geometrical, arithmetical, and harmonic means, and the kinds of greater and lesser inequality. Moreover, spiritual substances are known by philosophy only through the medium of the corporeal, and especially the heavenly bodies, as Aristotle teaches in the eleventh book of the Metaphysics. Nor are inferior things known except through superior ones, because the heavenly bodies are the causes of things that are lower. But the heavenly bodies are known only through quantity, as is clear from astronomy. Therefore all the categories depend on a knowledge of quantity of which mathematics treats, and therefore the whole excellence of logic depends on mathematics.

Chapter III

In which it is proved by reason that every science requires mathematics.

What has been shown as regards mathematics as a whole through authority, can now be shown likewise by reason. And I make this statement in the first place, because other sciences use mathematical examples, but examples are given to make clear the subjects treated by the sciences; wherefore ignorance of the examples involves an ignorance of the subjects for the understanding of which the examples are adduced. For since change in natural objects is not found without some augmentation and diminution nor do these latter take place without change; Aristotle was not able to make clear without complications the difference between augmentation and change by any natural example, because augmentation and diminution go together always with change in some way; wherefore he gave the mathematical example of the rectangle which augmented by a gnomon increases in magnitude and is not altered in shape. This example cannot be understood before the twenty-second proposition of the sixth book of the Elements. For in that proposition of the sixth book it is proved that a smaller rectangle is similar in every particular to a larger one and therefore a smaller one is not altered in shape, although it becomes larger by the addition of the gnomon.

Secondly, because comprehension of mathematical truths is innate, as it were, in us. For a small boy, as Tullius states in the first book of the Tusculan Disputations, when questioned by Socrates on geometrical truths, replied as though he had learned geometry. And this experiment has been tried in many cases, and does not hold in other sciences, as will appear more clearly from what follows. Wherefore since this knowledge is almost innate, and as it were precedes discovery and learning, or at least is less in need of them than other sciences, it will be first among sciences and will precede others disposing us toward them; since what is innate or almost so disposes toward what is acquired.

Thirdly, because this science of all the parts of philosophy was the earliest discovered. For this was first discovered at the

beginning of the human race. Since it was discovered before the flood and then later by the sons of Adam, and by Noah and his sons, as is clear from the prologue to the Construction of the Astrolabe according to Ptolemy, and from Albumazar in the larger introduction to astronomy, and from the first book of the Antiquities, and this is true as regards all its parts, geometry, arithmetic, music, astronomy. But this would not have been the case except for the fact that this science is earlier than the others and naturally precedes them. Hence it is clear that it should be studied first, that through it we may advance to all the later sciences.

Fourthly, because the natural road for us is from what is easy to that which is more difficult. But this science is the easiest. This is clearly proved by the fact that mathematics is not beyond the intellectual grasp of any one. For the people at large and those wholly illiterate know how to draw figures and compute and sing, all of which are mathematical operations. But we must begin first with what is common to the laity and to the educated; and it is not only hurtful to the clergy, but disgraceful and abominable that they are ignorant of what the laity knows well and profitably. Fifthly, we see that the clergy, even the most ignorant, are able to grasp mathematical truths, although they are unable to attain to the other sciences. Besides a man by listening once or twice can learn more about this science with certainty and reality without error, than he can by listening ten times about the other parts of philosophy, as is clear to one making the experiment. Sixthly, since the natural road for us is to begin with things which befit the state and nature of childhood, because children begin with facts that are better known by us and that must be acquired first. But of this nature is mathematics, since children are first taught to sing, and in the same way they can learn the method of making figures and of counting, and it would be far easier and more necessary for them to know about numbers before singing, because in the relations of numbers in music the whole theory of numbers is set forth by example, just as the authors on music teach, both in ecclesiastical music and in philosophy. But the theory of numbers depends on figures, since numbers relating to lines, surfaces, solids, squares, cubes, pentagons, hexagons, and other figures, are known from lines, figures, and angles.

For it has been found that children learn mathematical truths better and more quickly, as is clear in singing, and we also know by experience that children learn and acquire mathematical truths better than the other parts of philosophy. For Aristotle says in the sixth book of the Ethics that youths are able to grasp mathematical truths quickly, not so matters pertaining to nature, metaphysics, and morals. Wherefore the mind must be trained first through the former rather than through these latter sciences. Seventhly, where the same things are not known to us and to nature, there the natural road for us is from the things better known to us to those better known to nature, or known more simply; and more easily do we grasp what is better known to ourselves, and with great difficulty we arrive at a knowledge of those things which are better known to nature. And the things known to nature are erroneously and imperfectly known by us, because our intellect bears the same relation to what is so clear to nature, as the eye of the bat to the light of the sun, as Aristotle maintains in the second book of the Metaphysics; such, for example, are especially God and the angels, and future life and heavenly things, and creatures nobler than others, because the nobler they are the less known are they to us. And these are called things known to nature and known simply. Therefore, on the contrary, where the same things are known both to us and to nature, we make much progress in regard to what is known to nature and in regard to all that is there included, and we are able to attain a perfect knowledge of them. But in mathematics only, as Averroës says in the first book of the Physics and in the seventh of the Metaphysics and in his commentary on the third book of the Heavens and the World, are the same things known to us and to nature or simply. Therefore as in mathematics we touch upon what is known fully to us, so also do we touch upon what is known to nature and known simply. Therefore we are able to reach directly an intimate knowledge of that science. Since, therefore, we have not this ability in other sciences, clearly mathematics is better known. Therefore the acquisition of this subject is the beginning of our knowledge.

Likewise, eighthly, because every doubt gives place to certainty and every error is cleared away by unshaken truth. But in mathematics we are able to arrive at the full truth without

error, and at a certainty of all points involved without doubt; since in this subject demonstration by means of a proper and necessary cause can be given. Demonstration causes the truth to be known. And likewise in this subject it is possible to have for all things an example that may be perceived by the senses, and a test perceptible to the senses in drawing figures and in counting, so that all may be clear to the sense. For this reason there can be no doubt in this science. But in other sciences, the assistance of mathematics being excluded, there are so many doubts, so many opinions, so many errors on the part of man, that these sciences cannot be unfolded, as is clear since demonstration by means of a proper and necessary cause does not exist in them from their own nature because in natural phenomena, owing to the genesis and destruction of their proper causes as well as of the effects, there is no such thing as necessity. In metaphysics there can be no demonstration except through effect, since spiritual facts are discovered through corporeal effects and the creator through the creature, as is clear in that science. In morals there cannot be demonstrations from proper causes, as Aristotle teaches. And likewise neither in matters pertaining to logic nor in grammar, as is clear, can there be very convincing demonstrations because of the weak nature of the material concerning which those sciences treat. And therefore in mathematics alone are there demonstrations of the most convincing kind through a necessary cause. And therefore here alone can a man arrive at the truth from the nature of this science. Likewise in the other sciences there are doubts and opinions and contradictions on our part, so that we scarcely agree on the most trifling question or in a single sophism; for in these sciences there are from their nature no processes of drawing figures and of reckonings, by which all things must be proved true. And therefore in mathematics alone is there certainty without doubt.

Wherefore it is evident that if in other sciences we should arrive at certainty without doubt and truth without error, it behooves us to place the foundations of knowledge in mathematics, in so far as disposed through it we are able to reach certainty in other sciences and truth by the exclusion of error. This reasoning can be made clearer by comparison, and the principle is stated in the ninth book of Euclid. The same holds

true here as in the relation of the knowledge of the conclusion to the knowledge of the premises, so that if there is error and doubt in these, the truth cannot be arrived at through these premises in regard to the conclusion, nor can there be certainty, because doubt is not verified by doubt, nor is truth proved by falsehood, although it is possible for us to reason from false premises, our reasoning in that case drawing an inference and not furnishing a proof; the same is true with respect to sciences as a whole; those in which there are strong and numerous doubts and opinions and errors, I say at least on our part, should have doubts of this kind and false statements cleared away by some science definitely known to us, and in which we have neither doubts nor errors. For since the conclusions and principles belonging to them are parts of the sciences as a whole, just as part is related to part, as conclusion to premises, so is science related to science, so that a science which is full of doubts and besprinkled with opinions and obscurities, cannot be rendered certain, nor made clear, nor verified except by some other science known and verified, certain and plain to us, as in the case of a conclusion reached through premises. But mathematics alone, as was shown above, remains fixed and verified for us with the utmost certainty and verification. Therefore by means of this science all other sciences must be known and verified.

Since we have now shown by the peculiar property of that science that mathematics is prior to other sciences, and is useful and necessary to them, we now proceed to show this by considerations taken from its subject matter. And in the first place we so conclude, because the natural road for us is from sense perception to the intellect, since if sense perception is lacking, the knowledge related to that sense perception is lacking also, according to the statement in the first book of the Posterior Analytics, since as sense perception proceeds so does the human intellect. But quantity is especially a matter of sense perception, because it pertains to the common sense and is perceived by the other senses, and nothing can be perceived without quantity, wherefore the intellect is especially able to make progress as respects quantity. In the second place, because the very act of intelligence in itself is not completed without continuous quantity, since Aristotle states in his book on Memory and Recollec-

tion that our whole intellect is associated with continuity and time. Hence we grasp quantities and bodies by a direct perception of the intellect, because their forms are present in the intellect. But the forms of incorporeal things are not so perceived by our intellect; or if such forms are produced in it, according to Avicenna's statement in the third book of the Metaphysics, we, however, do not perceive this fact owing to the more vigorous occupation of our intellect in respect to bodies and quantities. And therefore by means of argumentation and attention to corporeal things and quantities we investigate the idea of incorporeal things, as Aristotle does in the eleventh book of the Metaphysics. Wherefore the intellect will make progress especially as regards quantity itself for this reason, that quantities and bodies as far as they are such belong peculiarly to the human intellect as respects the common condition of understanding. Each and every thing exists as an antecedent for some result, and this is true in higher degree of that which has just been stated.*

Moreover, for full confirmation the last reason can be drawn from the experience of men of science; for all scientists in ancient times labored in mathematics, in order that they might know all things, just as we have seen in the case of men of our own times, and have heard in the case of others who by means of mathematics, of which they had an excellent knowledge, have learned all science. For very illustrious men have been found, like Bishop Robert of Lincoln and Friar Adam de Marisco, and many others, who by the power of mathematics have learned to explain the causes of all things, and expound adequately things human and divine. Moreover, the sure proof of this matter is found in the writings of those men, as, for example, on impressions such as the rainbow, comets, generation of heat, investigation of localities on the earth and other matters, of which both theology and philosophy make use. Wherefore it is clear that mathematics is absolutely necessary and useful to other sciences.

These reasons are general ones, but in particular this point can be shown by a survey of all the parts of philosophy disclosing how all things are known by the application of mathematics. This amounts to showing that other sciences are not to

* The Latin of this sentence is obscure.

be known by means of dialectical and sophistical argument as commonly introduced, but by means of mathematical demonstrations entering into the truths and activities of other sciences and regulating them, without which they cannot be understood, nor made clear, nor taught, nor learned. If any one in particular should proceed by applying the power of mathematics to the separate sciences, he would see that nothing of supreme moment can be known in them without mathematics. But this simply amounts to establishing definite methods of dealing with all sciences, and by means of mathematics verifying all things necessary to the other sciences. But this matter does not come within the limits of the present survey.

SECOND DISTINCTION

In which it is shown that the matters of this world require mathematics. The distinction has three chapters.

Chapter I

In the first chapter it is shown in general that celestial and terrestrial things require mathematics.

WHAT has just been shown in regard to the sciences can be made clear in regard to things. For the things of this world cannot be made known without a knowledge of mathematics. For this is an assured fact in regard to celestial things, since two important sciences of mathematics treat of them, namely theoretical astrology and practical astrology. The first considers the quantities of all that is included in celestial things, and all things which are reduced to quantity discontinuous as well as continuous. For it gives us definite information as to the number of the heavens and of the stars, whose size can be comprehended by means of instruments, and the shapes of all and their magnitudes and distances from the earth and thicknesses and number, and greatness and smallness, the rising and setting of the signs of the stars, and the motion of the heavens and the stars, and the numbers and varieties of the eclipses. It likewise treats of the size and shape of the habitable earth and of all great divisions which are called climes, and it shows the difference in horizons and days and nights in the different climes. These matters, therefore, are determined by this branch of the subject as well as many things connected with them. Practical astrology enables us to know every hour the positions of the planets and stars, and their aspects and actions, and all the changes that take place in the heavenly bodies; and it treats of those things that happen in the air, such as comets and rainbows and the other changing phenomena there, in order that we may know their positions, altitudes, magnitudes, forms, and many things that must be considered in them. All this information is secured by means of instruments suitable for these purposes, and by tables and by canons, that is, rules invented for the verification of these

matters, to the end that a way may be prepared for the judgments that can be formed in accordance with the power of philosophy, not only in the things of nature, but in those which take their tendency from nature and freely follow celestial direction; and not only for judgments in regard to present, past, and future, but for wonderful works, so that all things prosperous in this world may be advanced, and things adverse may be repressed, in a useful and glorious way. Nor are these matters doubtful. For the patriarchs and prophets from the beginning of the world had full information respecting these matters as well as all others. Aristotle restored the knowledge of the ancients and brought it to light. All those informed in great subjects agree in this, and experience teaches it. But concerning these matters an exposition will be given in the proper place.

It is plain, therefore, that celestial things are known by means of mathematics, and that a way is prepared by it to things that are lower. That, moreover, these terrestrial things cannot be learned without mathematics, is clear from the fact that we know things only through causes, if knowledge is to be properly acquired, as Aristotle says. But celestial things are the causes of terrestrial. Therefore these terrestrial things will not be known without a knowledge of the celestial, and the latter cannot be known without mathematics. Therefore a knowledge of these terrestrial things must depend on the same science. In the second place, we can see from their properties that no one of these lower or higher things can be known without the power of mathematics. For everything in nature is brought into being by an efficient cause and the material on which it works, for these two are concurrent at first. For the active cause by its own force moves and alters the matter, so that it becomes a thing. But the efficacy of the efficient cause and of the material cannot be known without the great power of mathematics even as the effects produced cannot be known without it. There are then these three, the efficient cause, the matter, and the effect. In celestial things there is a reciprocal influence of forces, as of light and other agents, and a change takes place in them without, however, any tendency toward their destruction. And so it can be shown that nothing within the range of things can be known without the power of geometry. We learn from this line of reasoning that in like manner the other parts of mathematics

are necessary; and they are so for the same reason that holds in the case of geometry; and without doubt they are far more necessary, because they are nobler. If, therefore, the proposition be demonstrated in the case of geometry, it is not necessary in this plea that mention be made of the other parts.

In the first place, I shall demonstrate a proposition in geometry in respect to the efficient cause. For every efficient cause acts by its own force which it produces on the matter subject to it, as the light of the sun produces its own force in the air, and this force is light diffused through the whole world from the solar light. This force is called likeness, image, species, and by many other names, and it is produced by substance as well as accident and by spiritual substance as well as corporeal. Substance is more productive of it than accident, and spiritual substance than corporeal. This species causes every action in this world; for it acts on sense, on intellect, and all the matter in the world for the production of things, because one and the same thing is done by a natural agent on whatsoever it acts, because it has no freedom of choice; and therefore it performs the same act on whatever it meets. But if it acts on the sense and the intellect, it becomes a species, as all know. Accordingly, on the other hand, if it acts on matter it also becomes a species. In those beings that have reason and intellect, although they do many things with deliberation and freedom of will, yet this action, namely, a production of species, is natural in them, just as it is in other things. Hence the substance of the soul multiplies its own force in the body and outside of the body, and any body outside of itself produces its own force, and the angels move the world by means of forces of this kind. But God produces forces out of nothing, which he multiplies in things; created agents do not do so, but in another way about which we need not concern ourselves at the present time. Forces of this kind belonging to agents produce every action in this world. But there are two things now to be noted respecting these forces; one is the multiplication itself of the species and of force from the place of its production; and the other is the varied action in this world due to the production and destruction of things. The second cannot be known without the first. Therefore it is necessary that the multiplication itself be first described.

Chapter II

In which the canons of the multiplication of the forces of agents as respects lines and angles are explained.

Every multiplication is either with respect to lines, or angles, or figures. While the species travels in a medium of one rarity, as in what is wholly sky, and wholly fire, and wholly air, or wholly water, it is propagated in straight paths, because Aristotle says in the fifth book of the Metaphysics that nature works in the shorter way possible, and the straight line is the shortest of all. This fact is also made evident by the twentieth proposition of the first book of Euclid, which states that in every triangle two sides are longer than the third.

But when the second body is of another rarity and density, so that it is not wholly dense, but changes in some way the passage of the species, like water, which in one way is rare, and in another dense, and crystal similarly, and glass and the like, through the media of which we are able to see, then the species either impinges upon the second body perpendicularly, and still travels along the straight line as in the first medium; or if it does not fall perpendicularly, then of necessity it changes its straight path, and makes an angle on entering the second body, and its declination from the straight path is called refraction of the ray and the species. This is because the perpendicular is the stronger and shorter, and therefore nature works in a better way on it, as geometrical demonstrations show, of which mention will be made later more particularly in the proper place. But this refraction is twofold, since if the second body is denser, as is the case in descending from the sky to these lower objects, all the forces of the stars that do not fall perpendicularly on the globe of elements, are broken between the straight path and the perpendicular drawn from the place of refraction. If the second body is rarer, as is the case in ascending from water into the air, the straight path falls between the refracted ray and the perpendicular drawn from the place of refraction. And this is a wonderful diversity in the action of nature, but it is not strange, when countless wonders are performed by nature in accordance with the laws of these refractions; and by means of art aiding nature those things can be

done which the world cannot receive, as I shall explain in perspective science. But it will be driven by these means in the times of Antichrist to those things which it will itself wish for in great part.

That, moreover, these things are true authorities teach, and all experts know, and instruments can be made so that we may sensibly see propagations of this kind; but until we have instruments we can prove this by natural effect without contradiction, as this figure shows. Let us take then a hemisphere of crystal or a glass vessel, the lower part of which is round and full of water. When, therefore, rays come from the center of the sun to the body of crystal, or of glass, which is denser than the air, those that are not perpendicular to such a body (and these are the ones that do not pass through its center, as is clear from geometric principles) are refracted between the straight path and the perpendicular drawn from the point of refraction, as is the ray *ac,* which after passing through the whole body of the vessel, comes obliquely to the air which is of less density. Of necessity, therefore, it so travels that the straight path is between the path of the ray and the perpendicular drawn to the point of refraction, and therefore the ray will not travel to *c,* but bends to *f,* on the principal perpendicular, which comes from the sun, that is, ray *Of.* And in the same way at any other point, owing to the double refraction, *hf* will pass through the same point *f* on the ray *Of.* But an infinite number of rays come forth from every point on the sun to the body; therefore an infinite number will meet in this same point by means of the double refraction. But a convergence of rays is the cause of heat. Therefore a burning heat will be produced at this point. And this is a fact, as is clear to the sense; for if a combustible be placed at this point, as wool, silk, or a piece of rag, it will be consumed. Since, therefore, there is combustion at this point and this can-

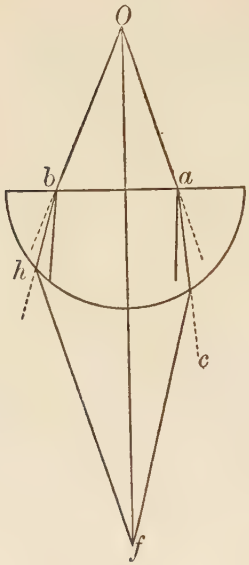


FIG. 1.

not happen except through a convergence of rays, and the rays cannot assemble except through a double refraction, because a single refraction would not suffice and a third refraction is not required, therefore we must assume this kind of refraction, a wonderful thing in the eyes of men of science. For why is it that nature so acts? Surely nothing is pleasing to nature, or to her will, except what is remade by change; but the causes are hidden. We need not now investigate the causes, since we know this marvel by means of a very certain test, and in what follows other tests will be added.

When, however, the second body is so dense as in no way to permit the passage of the species,—I am speaking of a passage appreciated by human vision,—we say that the species is reflected. Yet according to Aristotle and Boetius the vision of the lynx penetrates walls. Therefore the species does actually pass through as a matter of fact; but human vision forms no judgment concerning this, but does concerning the reflection which of necessity takes place. For on account of the difficulty of passage through the dense medium, since in the air from which it came it finds an easy road, it multiplies itself more abundantly in the direction from which it came. And this in the first place can happen in general in two ways; for either the ray falls perpendicularly on the dense body and then returns upon itself wholly by the same path by which it came, and a ray is generated in the same place, as for example the ray *ab* falls perpendicularly, and this is in planes at right angles, as is shown in the eleventh book of geometry, just as in spherical shaped bodies when the ray passes through the center. And the reason for this is that the angles of incidence and reflection are always equal, as a manifold demonstration shows, and authorities maintain, and instruments made for this purpose make clear to the eye. But there are only two right angles at the dense body in the case of *ab*. Therefore by these same angles the reflex ray will return upon itself and therefore in the same place. But the line *ac* which falls at oblique angles and not perpen-

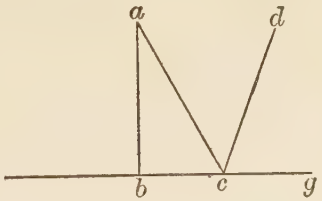


FIG. 2.

dicularly, does not return upon itself, but passes to *d,* because of the equality of the angles of incidence and reflection. Whenever the ray falls at oblique angles, the acute angle is called the angle of incidence; and from the obtuse angle an angle equal to the angle of incidence is cut off by the reflected line. The angle so formed is contained between the reflected line and the dense body, as is the angle *dcg,* and it is called the angle of reflection, which of necessity must equal the acute angle on the other side, and we prove this to the sight in mirrors. For we cannot see things, unless the eye is in the line of reflection, as if the eye be at *d* it will see *a;* and if not, it will not see by means of that reflected ray. These are known facts, and tests will be given adequately concerning this matter in what follows.

Moreover, an infinite number of rays can be assembled by reflection, just as by multiplication, so that strong combustions take place. But from a plain surface rays cannot converge to one point, because one goes to one point, another to another point. Nor can they do so from a convex mirror; but they can converge from a concave spherical mirror, or from one column-shaped, or pyramidal, or ring-shaped, or oval, and so too from others. If, therefore, a concave spherical mirror be exposed to the sun, an infinite number of rays will converge to one point by means of reflection. And therefore of necessity fire is kindled when a concave mirror is exposed to the sun, as is stated in the last proposition of the book on Mirrors, and the demonstration is there given. But an instrument might very well have been made for this purpose, and the phenomenon would then be visible to the eye, as we stated before in the case of refraction. Hence if a mirror should be made of good steel, or of silver, the combustion would occur more easily; but a combustion does not take place by all rays falling on a mirror, but by those only which fall on the circumference of a circle around the axis of the mirror, because all that fall in one circumference fall at equal angles, and therefore are reflected to a point on the axis, because the angles of the reflected rays are equal, and those that fall in another circle are reflected to another point, and those in a third circle to a third point, and the same statement may be made of an infinite number of circles imagined around the axis of the mirror; for of necessity rays falling on different circumferences travel to different points, because they do not

fall at equal angles. Those falling in a smaller circle are reflected higher, and those in the greatest circle are reflected to the lowest point, namely to the pole of the sphere, or to the end of the axis. But neither nature nor art is content with combustion of this kind, nay, they wish so to fashion bodies that all the rays falling on the whole surface of the mirror may converge to a single point; and what is more at every distance we desire. This is the ultimate which the power of geometry can do. For this mirror would burn fiercely everything on which it could be focused. We are to believe that Antichrist will use these mirrors to burn up cities and camps and armies. Since if a moderate convergence of rays by refraction or by a concave mirror burns perceptibly, how much more so without limit, when rays without number converge by means of this mirror. Scientists reckon that this is a necessary consequence. And an author in a book on burning mirrors shows how this instrument is made, but without sufficient reason hid in that book much respecting the artifice, and states that he has placed the lacking information in another book, which has not been translated by the Latins. But there are Latins who because of the ill favor of that author in concealing the perfection of his knowledge, have studied this wonderful secret of nature, because that author stimulates greatly men skilled in science to perfect what is lacking, and he shows that the mirror must be nearly ring-shaped or oval, as if the cones of an egg were cut off, the figure would be ring-shaped; if, however, one cone remains, it is oval. Now in such a figure properly constructed all the rays falling on the whole surface must fall at equal angles, and therefore they must be reflected at like angles, and for this reason to one point. Moreover, the most skillful of the Latins is busily engaged on the construction of this mirror, and the glory of your Magnificence will be able to order him to complete it when he is known to you. This triple multiplication is said to be a principal one, because it comes from the agent itself.

But the fourth kind is more necessary to the world, although it is called accidental multiplication. For light is called accidental with respect to the principal light coming from an object, since it does not come from an agent, but from principal multiplications, as in a house the principal multiplication falls through the window from the sun, but in a corner of the house

the accidental light comes from the ray of the window. Moreover, the bodies of mortals would not be able to be exposed always to principal species without destruction, and for this reason God has tempered all things by means of accidental species of this kind.

The fifth kind is different from the others, for it does not follow the common laws of nature, but claims for itself a special privilege. This multiplication does not take place except in an animated medium, as in the nerves of the senses; for the species follows the tortuous course of the nerve, and pays no attention to the straight path. This happens through the force of the vital principle regulating the path of the species, as the actions of an animated being require. Concerning this propagation something will be said in the truths of perspective. The first four in respect to which nature delights to work are common to the inanimate things of the world; the fifth is known to pertain to sensation.

Chapter III

In which multiplication is given as respects figures.

We must next consider how multiplication takes place with respect to figures. Multiplication of necessity takes place in the form of a sphere. For the agent multiplies itself equally in every direction, and with respect to all diameters, and all differences of position, namely, above, below, before, behind, to the right, and to the left. Therefore everywhere the lines go forth in every direction from the agent as from a center: but lines traveling everywhere from one place cannot terminate except on the concave surface of a sphere. And this is clear, because the eye sees only by means of the coming species, but if an infinite number of eyes were placed everywhere, all would see the same thing; therefore the species goes forth by means of an infinite number of lines; but an infinite number of lines terminate only on a spherical surface. If it should be said that light entering through a large triangular opening or through one of another polygonal figure does not fall in spherical form, but does so when it enters through a small opening, we must state that the sides of the small opening are not far apart and

therefore the light in a short distance is able to regain its figure, but when it passes through a large figure, it cannot do so easily, but it will do so at some sufficient distance, if obstacles are removed. This principle is made evident by the fourteenth and fifteenth propositions of the first book of the elements of Euclid, as the figure shows. For let the rays be drawn as far from the in-

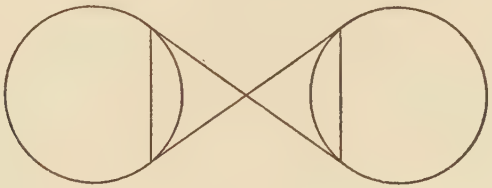


Fig. 3.

tersection as from the intersection to the sun, by the propositions mentioned the bases of the triangles must be equal. But those bases are the diameters of the lights. Therefore the diameter of the species is necessarily equal to the diameter of the sun at some one distance, and consequently the multiplication will be an equal spherical one, and can be varied according to difference of distance, but it will always be of spherical form. Nor is the light of fire a case in point, which ascends in the form of a pyramid; because this is not a multiplication from the proper nature of light, but is owing to the motion of the body of the fire itself, of which light is an accident, and the accident moves in accordance with the motion of its subject, like the light of the sun in the sun. Now fire must ascend in pyramidal form, since the interior parts are removed from the surrounding cold, and therefore they are less impeded and extricate themselves more quickly than the parts on the outside, and for this reason rise higher, and the remaining parts the nearer they are to these, the more quickly do they extricate themselves, and they attach themselves to the ones in the interior, failing somewhat to reach the height of the inmost parts, and so in regular gradation the remoter ones reach a lesser height, because they are more impeded by the contrary force surrounding them; and therefore a pyramid must necessarily be formed. But in the sphere all regular figures can be inscribed, as is clear from the

fifteenth book of the elements of Euclid, among which figures is the pyramid.

And although according to the principle of inscribing geometrical figures irregular ones cannot be inscribed, nor round figures, nevertheless all figures can be produced and marked on the sphere. And therefore not only in spherical multiplication shall we find pyramids with sides, which can be inscribed in a sphere, but also round* pyramids, which can be marked and drawn in spherical multiplication. And it is this figure that nature especially selects in every multiplication and action, and not any pyramid at all, but that one whose base is the surface of the agent and whose vertex falls on some point of the surface acted on, because in this way can the species of the agent come to each point of the surface acted on by means of an infinite number of separate pyramids, as is clear in the figure.

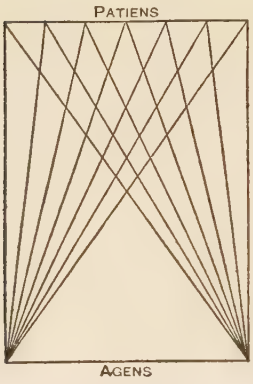


FIG. 4.

For from each point of the surface acted on there are an infinite number of rays and therefore they can be combined infinitely to form an infinite number of round pyramids with one common base, namely, the surface of the whole agent; and to every part of the surface acted on there comes an apex of a pyramid, so that force comes from the whole agent to each point of the surface acted on, and not from some limited part, to the end that the force may come complete and as a whole, not partial and imperfect, so that the action may be complete, because nature acts in accordance with what is better.

* Bacon's expression for a cone.

THIRD DISTINCTION

In which the difference of natural action is made clear by means of geometry. This distinction has three chapters.

Chapter I

AFTER considering these facts in regard to multiplication, we must take up some matters in regard to ulterior action. For light by means of its multiplication makes a luminous image, and this action is called univocal, because the effect is univocal, and of one kind and conformable to the agent. But there is another equivocal multiplication, as light generates heat, heat generates putrefaction, putrefaction death, and wine inebriates, and so of every agent, because it produces many effects besides its own species and force univocal to itself. And so the sun and stars cause all things here below, and the angels move the heavens and the stars, and the soul its own body; the force, however, of the agent does all those things, and this is complete action of the agent and of its force and the one desired finally by nature. Concerning this action therefore some canons or rules must be considered. These rules relate chiefly to this action, and yet they have place in a univocal action and contain truth in regard to it.

Nature, therefore, as has been said, works more effectively in a straight line than in a curve, because the former is shorter, and causes the surface acted on to be less distant from the agent, and therefore it receives more of the force of the agent, as he who is near a fire is warmer than one farther away. But the equal is better than the unequal, as Boetius states in the practical part of his Geometry. But in the straight line there is equality. Likewise every united force is of stronger action, as is stated in the book on Causes. But uniformity and unity are greater in the straight line, as Aristotle states in the fifth book of the Metaphysics. For in the curve is an angle, which causes dispersion and irregularity in form and resists unity. Therefore nature acts with more force in the straight line than in the broken or reflected one. But the straight line, which falls at equal angles and perpendicularly either on planes or on spheri-

cal bodies, is the one on which nature chooses to work both on account of its equality and greater uniformity, and on account of its shortness. For by the nineteenth proposition of the first book of the elements of Euclid, in every triangle the greater side is opposite the greater angle. But from the seventeenth proposition of the same book, the greater angle in a triangle is the right angle, namely *acb*. Therefore the greatest side, *ab,* is opposite this angle. But this line does not fall perpendicularly. Therefore the perpendicular is shorter; wherefore the force coming along it will act more strongly. Moreover, the effectiveness of a perpendicular force is shown not only by demonstration, but also by experience, whence a stone falling from a height perpendicularly strikes with more force; and if a man falls from a height perpendicularly he is hurt more: for should any one divert from the perpendicular path a man falling from a height, he would not be injured, provided he was near the ground. If this help is not given he will die from the perpendicular fall, and will be shattered completely.

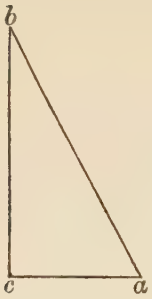


Fig. 5.

And we must consider that if from different points of the agent rays come to the same thing, one perpendicular to the agent and another not perpendicular to it, the perpendicular will always be the shorter. Let *ac* represent the agent, then *ab* is shorter than *cb,* and therefore stronger for this reason. And although *cb* falls on *ed,* a surface acted on at right angles, and *ab* does not, so that *cb* will be strengthened for this reason, nevertheless it will not reach the strength of *ab,* because *ab* is shorter, and because the point *b* of *ed* is likewise a point of another line, as *fg,* to which *ab* is perpendicular, and so the explanation of a body acted on is applicable in its main point to *b*. And the action in particular is most complete on a spherical body, since the force does not fall there at some angle, but

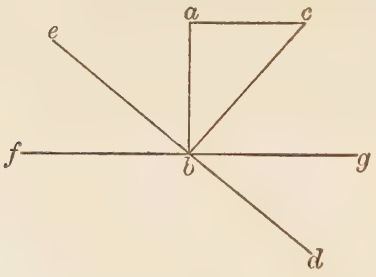


Fig. 6.

passes through the surface and the spherical body, and there is no difference or difformity and completeness of action is there found. For unless circles be marked on the sphere, there is no angle there; but when they are marked the angles of the perpendicular line will be equal, just as in planes, and the action will be complete. But, however, they are not right angles, but obtuse, as is clear from geometry.

In the second place, we must know that nature works on broken lines more strongly than on reflected ones, because refraction is in the direction of the straight path, but reflection advances in the opposite direction, and contrary to the natural path which the nature of the advancing force seeks in continuity and direction unless it is impeded, and therefore reflection weakens greatly the species and the force, and much more so than refraction. But this is to be understood of refraction and reflection as regards the peculiar property of forward motion in them. If, however, we consider that reflection takes place in the same medium, and refraction in different ones, of necessity the double medium impedes more than the single, and this is the case at least when reflection takes place in a rare medium and the refraction in a second denser medium, as in a glass vessel. For if rays should be assembled from a burning mirror and behind a burning glass, the combustion is of necessity greater, as will be explained below in the proper places. Refraction which takes place in a second denser body weakens less than in a second rarer body. For the perpendicular advance is the strongest, and therefore that which approaches nearer to the perpendicular is the stronger. But refraction in a second denser body is deflected toward the perpendicular, which is erected at the same point at which the refraction takes place, as is clear above in the figure, both in planes and in spheres, and therefore that kind weakens less. In the case of reflection at right angles, although the ray is accidentally doubled, and thus the action becomes stronger, yet it is in accordance with the nature of that reflection that by repeating itself it weakens the species more; for it is wholly opposed to the natural effort of the species itself, since the species returns by the same line by which it came. But when the reflection takes place at oblique angles, it is not wholly in the opposite direction, but to the side, and therefore this reflection does not weaken so much as the

other. I am speaking in reference to the nature of the reflection, but owing to the doubling of the force in the same place and owing to the equality of the angles and the conditions of the perpendicular, the action is stronger. And yet we must here consider that by the falling of rays at oblique angles more rays can be assembled by intersection than by rays falling at right angles, not only from the property of mirrors, as has been said, but because of rays meeting in infinite numbers in accordance with the law of incidence and reflection at oblique angles, just as happens in the air, because owing to the falling of rays of this kind and their reflection the rays intersect one another at every point in infinite number, and heat is produced. For few rays are incident perpendicularly on any body, because from a point of the agent only one perpendicular ray falls to a point of the surface acted on, and therefore few are reflected. But an infinite number of non-perpendicular rays proceed from each point of the agent, and an infinite number corresponding to these are reflected. Then by the perpendicular falling only two are united at the same point in the air, namely, the incident ray and its equal reflected ray. But by the falling at oblique angles an infinite number intersect one another at every point in the air. And likewise incident rays penetrate reflected ones that do not belong to them, and reflected rays penetrate reflected ones in countless numbers. For at every point of the earth rays in infinite number are incident, and from the same point infinite numbers are reflected, and therefore a stronger action is produced in this way accidentally from the incident and the reflected rays at oblique angles than at right angles. Art, moreover, is able to aid nature in bringing about the action; for it can form mirrors in such a way that a great convergence of forces is produced by means of concave mirrors, and especially by those of oval shape, just as has been stated. But the principal force, namely, the straight refracted and reflected one, is stronger than the accidental, because the accidental one does not come from the agent, but from the species of the agent, and it is the species of a species, and for this reason is weaker.

Chapter II

In which the strength of action according to figures is considered.

And since the pyramid, as has been said, is required for the action of nature, we must consider that the apex of the shorter pyramid acts more strongly, both because it is less distant from the agent, and because the rays conterminal around the apex of the shorter pyramid are in closer proximity, and proximity of rays and convergence act more strongly; and this is shown in the figure. For by the thirteenth proposition of the first book of the elements of Euclid, all the angles around a single point in a surface are equal to only four right angles, therefore the four angles at the apex of the shorter pyramid equal the remaining four at the apex of the longer pyramid. But by the twenty-first proposition of the same book, the angle in the apex of the shorter pyramid is greater than the angle in the apex of the longer pyramid, namely, *a* is greater than *c;* and by the fifteenth proposition of the same book, angles placed opposite are equal, namely, *a* and *b,* likewise *c* and *d;* therefore *c* and *d* taken together are less than *a* and *b* taken together; therefore since the four taken together equal the other four so taken by the thirteenth proposition, of necessity *h* and *l* are greater than *f* and *e*. Wherefore the rays containing *e* are in greater proximity than the rays containing *h*. And in the same way the rays containing *f* are nearer than the rays containing *l,* and so of an infinite number of rays conterminal in the shorter pyramid, and of necessity all of them are in closer proximity than the rays conterminal in the apex of the longer pyramid. But proximity of forces is the cause of stronger action. But, however, since the forward motion of perpendicular rays is the strongest, and every deflection toward perpendiculars is stronger than deflection away from them, the rays of the

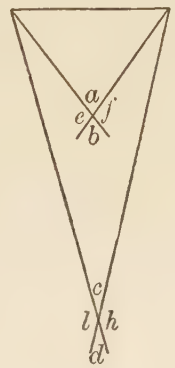


Fig. 7.

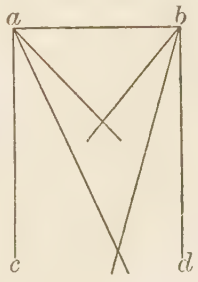


Fig. 8.

longer pyramid, since they deflect more toward the perpendiculars *ac, bd* will be stronger. Likewise as many rays come to the apex of the longer pyramid as to the apex of the shorter, since they are infinite in number on both sides. But the apex of the longer pyramid has the more acute angle by proposition XXI. Therefore its rays are the more united. Therefore they will burn more strongly. And we must state that these reasons are demonstrations for both conditions, but they are stronger for the first condition, and therefore they outweigh the other. Whence, as far as the last reasons can, so far do they draw conclusions, but there are other more potent ones and more effective in action.

Chapter III

Explaining how much of the surface acted on is changed and how much of the agent produces the change.

To these statements we must add that in equal spherical bodies the half of each receives the force of the other, because the extreme rays touch those bodies, and therefore they pass through the ends of the diameters, and no ray reaches any part of the other half. But the lesser body receives the force of the greater in its own larger portion, because the extreme rays are not equidistant always, but converge and are able to embrace more than half of the smaller. For the diameter of the greater sphere is greater than the diameter of the smaller; and therefore rays coming from the ends of the diameter of the greater

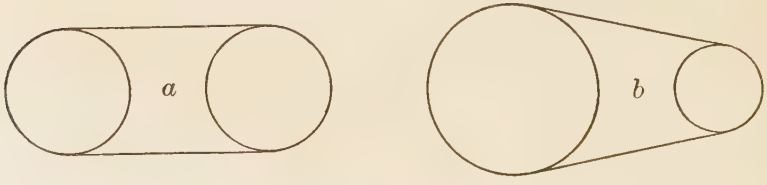


Fig. 9.

body are able to pass beyond the diameter of the smaller body so as to embrace the larger portion of it; and on the contrary the smaller portion of the larger body receives the force from

the smaller body, because the diameter of the smaller body does not equal the diameter of the larger, but equals some chord of the smaller portion of the larger body. And no point of a spherical body can exert a force from it except to the space which is separated from it by a line touching that body in that point from which the force acts; since from the point *a* no other line can fall between the tangent line and the spherical body, as is proved in the fifteenth proposition of the third book of the elements of Euclid. And therefore the space which is in the angle of tangency, as well as that back of the whole tangent line on the side of the body, will not receive the force from the point *a,* but all the space beyond the tangent line, in which are the points *bcde* will receive the force. And all rays coming forth from the surface of the spherical body, whose direction falls to the center of that body, are perpendicular to it and such lines come forth everywhere in infinite numbers, as is shown in the figure. And yet from the same point on the surface of a body, at which the ray is perpendicular, there are an infinite number of rays on the same body, as is shown at the point *a,* and this is true of all points; but only one ray, namely, *ab,* is perpendicular to that body, because, it alone, if produced continuously and in a straight line, passes through the center of the body, and therefore it is the strongest and possesses more force by far.

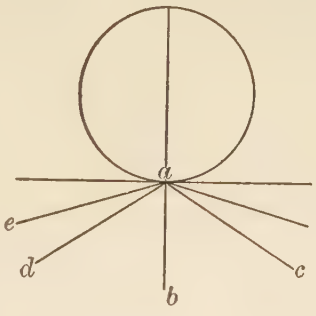


Fig. 10.

And those perpendicular rays, because they meet at the center of the body, are not equidistant; yet the eye can be so far distant from the body that it does not perceive their meeting, and judges such rays to be equidistant, as we experience in the case of rays from the sun and stars, and therefore we judge the shadows of different things equidistant when they are opposite to the sun, but we do not do so in accordance with the fact. For we think that many things are equidistant, because we do not perceive their meeting, as the walls of any house seem equidistant to our sense, but they are not so, because everything with weight tends naturally to the center, and therefore the house would fall if the

walls were absolutely equidistant. And the meridian circles of different states seem to be equidistant, and the meridian lines, because we do not perceive their meeting, and yet they do meet at the pole of the earth.

We should also know that rays falling to the center of the spherical body from which they come are the ones by which we judge when we consider the stars through the openings of instruments. Hence the astronomer and the man working with perspective, who examine matters of this kind, make use of those rays, because they are perceived by the senses and are strong. For although from some portion of a spherical body opposite to the thing acted on there comes a pyramid with infinite rays, which are from the individual points of that portion, and all rays converge at the apex of the pyramid with the perpendicular ray, yet one alone is perpendicular in a pyramid, and that perpendicular is superior in strength, and is the axis of the pyramid and the whole pyramid is named from it by experimenters, and it is called the ray of the acting body, as is shown in the figure. For let *a* be the center, and *dc* the por-

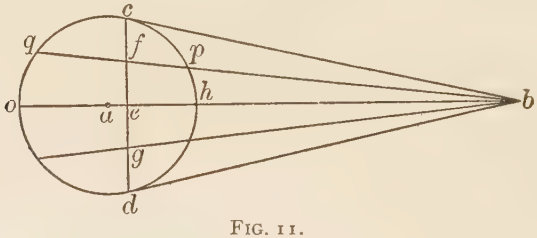


FIG. 11.

tion of the sun opposite to the earth, and *b* the apex of the pyramid falling upon the earth; it is evident that the ray *eb* falls to the center of the sun, and no others that are of the body of the pyramid, although they are infinite in number. For *gb* diverges from the center of the sun, as is clear, and so do all the others, *fb, cb*. And therefore it is perpendicular to the sun's body, and is the axis of the pyramid, and therefore is stronger and has more force, since force comes by this ray from the whole depth of the sun, which is not the case in the others. For the diameter *ho* is longer than *pq*, and longer than all lines falling in the circle to the side of the diameter, and therefore re-

ceives more of the sun's substance, and therefore has more force. And the line *hb* is shorter than *cb* and all other lines descending from the portion of the sun to the earth, wherefore it has more force according to the statements made. And that which has now been said is clear from the eighth proposition of the third book of the elements of Euclid.

FOURTH DISTINCTION

Chapter I

In which the rules cited are applied to the light of the stars.

BY these principles and the like given by means of geometry, a man can verify every action of nature, because every truth in regard to the action of an agent in a medium, or on matter in general, or on celestial bodies, and on the whole machine of the world, is derived mediately or immediately from the principles just stated, and from certain similar ones, because I have not been able to place in this plea all that a larger work requires. And I wish to illustrate my statement by some examples in different things of the world, and I shall begin with things above. Aristotle says in the first book of the Meteorologics that all the stars receive their light from the sun; and this is shown by an eclipse of the moon; for when the earth is interposed between the sun and the moon, the moon is eclipsed, and when the earth is not so placed, the moon is illuminated; and the same thing would happen in the case of other heavenly bodies, if they were in the same situation as the moon. But they are not, for the apex of the pyramid of shadow reaches only to the sphere of Mercury, and therefore the moon alone can fall within the earth's shadow. And yet the lower stars eclipse the higher ones, as Aristotle maintains in the second book of the Heavens and the World, when the lower ones fall between the sun and the higher ones, and this happens properly, but is not so visible as in the case of the moon. But since, as is clear from what has already been said, rare and transparent bodies permit the passage of the species, like the air, and since the species of the eye and of the stars pass through the sphere of fire, and through the medium of all the orbits of the seven planets, these media must of necessity be rare and transparent, and it is clear that they do not limit vision. Therefore they are not dense. Therefore they are invisible, because that only is visible, as Avicenna teaches in the third book on the Soul, which can terminate vision, and this is a fact. But if they are not visible, they are non-luminous, because what is luminous is visible. I am speaking of a luminous body with a

fixed light belonging to it and not one passing through it, a light which is able to multiply rays from itself, like a star and fire; I am not speaking of a luminous body that receives light passing through it, as the air, which Aristotle calls luminous in the second book on the Soul: this is an equivocal use of the word. Therefore they make a mistake who judge that the sphere of fire is naturally luminous, just as here below, and especially since it is rarer than air, and therefore less visible, and on this account less fitted for light, because density is a cause of illumination, as Averroës states in the second book of the Heavens and the World, and in the book on the Substance of the Sphere. And likewise a worse error is commonly made in maintaining that the spheres in which the stars move are luminous, especially when a false statement is made and imputed to Averroës. For it is said that a star does not differ from the sphere in which it moves except by a greater and lesser aggregation of light. But Averroës does not say this, but teaches and proves the contrary: for this whole statement is correct except the genitive case at the end, namely, *lucis* [of light], in place of which he says *perspicui coelestis* [of the transparent celestial substance]. And because almost all the words of the common statement and of Averroës himself are the same, and people consider transparent and luminous as the same because of Aristotle's use of the word in the second book on the Soul, where luminous is used in an equivocal sense, they impute to Averroës the teaching that the sphere in which a planet moves is luminous with a fixed light of its own, like a star, although less. But he states the contrary, maintaining that because of the strength of action that a star has in this world, it must of necessity have much of the substance of the heavens collected in its own body, and therefore the transparent celestial substance, which is dispersed in parts of the orbit, is condensed in the body of the star, so that it has a strong force in the alteration of the world. And therefore he teaches in this place and in his book on the Substance of the Sphere that the star alone is luminous, and no part of its orbit. And this error is common among those philosophizing and among all theologians when they speak and write about the stars.

Since in the book on the properties of the elements it is stated that the sun is like a candle and the stars are like mirrors, the

rank and file of students judge that the light coming to us from the moon and stars is the light of the sun reflected from their surfaces. But this is impossible because of the equality of the angles of incidence and reflection, as is shown in the figure. For as we saw before, if this were the case, the angle *a* of incidence must equal the angle *b* of reflection. Therefore the ray *bc* comes only to a definite portion of the earth and not everywhere, and this is true of all the light coming to the surface of the moon. For all the light is like a single ray, and falls at unequal angles, and is reflected to a definite part. Therefore if the light came to the earth, the moon would illuminate only some definite part of the horizon; but we see that it illuminates the whole hemisphere like the sun. Therefore that light which comes from the moon and stars is not reflected. Averroës in the second book of the Heavens and the World uses this demonstration, and confirms the fact by his own authority, that the light descending to us from the stars is not reflected from their surface, but belongs to them and is innate, yet derived from the potency of the matter in the body of the star through the force of the sun coming to the star, and this force alters and transforms the star and produces light in it; and when it has light naturally generated in it, just as the sun has created light, it is then able to multiply light from itself in all directions like the sun. And then only must we concede that the light of the sun is reflected from the surface of the moon, but the light does not come to the earth, but deflects to some part of the sky among the heavenly bodies in accordance with the equality of the angles of incidence and reflection.

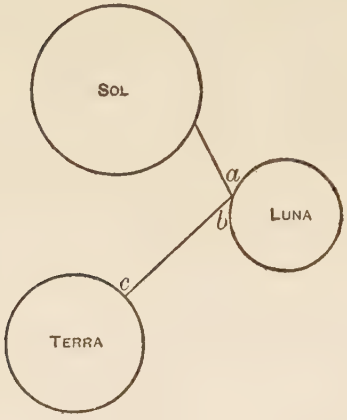


FIG. 12.

From the statements given above it is clear how much of the earth and of the stars is illuminated by the sun. For the greater portions of these are always illuminated, because they are less than the sun. For the sun is about 170 times larger than the

whole earth, as Ptolemy shows in the fifth book of the Almagest, and so all things pertaining to illuminations and protractions of rays in the heavenly bodies can be verified, as the difference in the moon's form according to periods, and the reason for her red and pallid appearance in eclipses, and the complete reason of the eclipse; for this is on account of the principal light, which comes from the principal rays below the shadow, and in a measure it is thus imperfectly illuminated by accidental rays. We can not only verify these matters, but the other forces produced by planets and stars on other stars in accordance with all the varying conjunctions and aspects, which astronomers employ in their studies and in which not only the rays of light, but the forces of the stars belonging to their substance in their turn are multiplied, respecting which we say that the moon in Aries is warm and dry, in Gemini warm and moist, and in Cancer cold and moist; and when she is in conjunction with Saturn she becomes cold and dry, and when with Jupiter warm and moist, and so of all such matters. For all these things are proved by the multiplications of species and of forces determined in accordance with the principles already touched upon. And not only these matters pertaining to the qualities and the natural substances of the stars are so verified, but also that which pertains to the figures, magnitudes, altitudes, and number of the heavens and of the stars, and to like things.

Chapter II

In which the rules quoted above are applied to the whole world.

These things are verified by the means stated not only as regards the celestial bodies, but also as regards the elements and the whole world. For although philosophers before Aristotle maintained all things were of one substance, this statement can be shown to be untrue by the laws of refraction. For if any one by means of the instruments used in astronomical investigation, such as armillary spheres or others, learns the position of a certain star about the equinoctial at its rising, and then learns the position of the same when it comes to the line of the meridian, he will find that it is sensibly more distant in its position on the meridian from the north pole of the heavens than

it was at rising. Therefore our vision sees the star in different ways at those different times; for if it saw the star in the same way, it would always find it in the same position. But when the star is on the meridian line, it approaches the zenith of the head of the observer, which is the point in the heavens directly overhead, wherefore the rays fall perpendicularly to the vision, and to the center of the world, and therefore they are not refracted, and for this reason the vision sees the star by means of straight lines in its true position. Therefore when the vision errs at the rising of the star, it will not see the star by means of perpendicular lines, because the star is far distant from the zenith above the head, and therefore the rays fall at oblique angles, for which reason they are refracted, and therefore the vision then sees by means of the broken lines, and errs in regard to the position of the star. So, moreover, Ptolemy in the fifth book on Optics teaches us to note this same fact, and Alhazen also in his seventh book, and I have noted it in instruments, and it is an assured fact. Since, therefore, the refraction of rays happens in this world, it is evident that there are many bodies in the world. And the first refraction is found according to the reason mentioned at the surface of fire immediately under the celestial sphere, namely, under the lunar sphere; wherefore the sphere of fire is different from the celestial sphere, although the followers of Plato and Augustine and many ancient authors mention in Platonic fashion that fire and the heavens are of one nature. But this is not possible, because of the demonstration mentioned and because of other natural demonstrations, which Aristotle gives in his book on the Heavens and the World, which no one in modern times contradicts; for this truth is well known in natural phenomena. This demonstration, however, is not known to the rank and file of writers on nature, for Aristotle does not touch upon it nor his expositors. Since, moreover, there is no refraction in the sphere of air, as those same authors teach, and there is the certainty of experience, therefore scientists are much disturbed over the question whether the sphere of air and of fire are two or one. For it seems according to the authors before mentioned and because of the removal of refraction that there is one surface of air and fire, and one body. But this is impossible, because Aristotle says in the third book of the Heavens and the World, that air is heavy in its own sphere, and

follows naturally the surface of water not of fire; for if fire mounted in its own sphere, air would not follow, as he states, because when water descends, air follows its surface, as we see with the eye. Wherefore air and fire are not one body; and all doubt is removed by the law of refraction. For three things are required for refraction, namely, that the second body have a surface distinct from the first, and that it be of a different rarity, namely, more rare or less rare, and that the rays fall at oblique angles. But if any one of these conditions is lacking, refraction is impossible. Because of the first condition refraction does not take place in the same body, although it may have one part more rare and another part less rare, as the air is rarer above than below. And because of the second condition there is no refraction in the celestial spheres, because they are of the same rarity, as far as we can perceive. And for this same reason there is no refraction in the sphere of air, because it gradually becomes rarer up to the point where it is equal in its highest part to the rarity of fire in its lower part, and therefore refraction does not take place there. Since, moreover, this refraction is between the straight path and the perpendicular drawn from the point of refraction, as these authors teach, and experience itself shows, therefore it follows that the second body is denser than the first and therefore the body under the celestial sphere is denser than the celestial sphere. Wherefore we must maintain a complete diversity of bodies with respect to the heavens and an element. And when we grasp these things, by the rays and the luminous pyramids of the stars coming to our instruments we shall verify all that concerns the heavenly bodies, namely, the number of the heavens, and the magnitude, altitude, and thickness of the stars, and all things that are in the heavens.

Chapter III

In which by means of the multiplications before mentioned the conditions of the localities of the world about its poles are investigated.

After these matters we shall take up the spheres of the elements and investigate all the conditions of these with respect

to the separate parts of our abode, and we shall find that the localities beneath the poles of the world are naturally uninhabitable because of the cold. Nor do the reasons noted above for the longer pyramids stand in our way, for, as was there stated, the demonstrations for the shorter pyramids outweigh the others in this particular, although every man ignorant of the rudiments of this kind of multiplication of light would judge in favor of the longer pyramids. But the fact is that the apexes of the pyramids coming to the places beneath the poles are too far distant from the sun, and are therefore weak, and are capable only of raising vapors from the water and the earth into the air, and are not able to consume them; and for this reason the air is of necessity dense and foggy and congealed by vapors everywhere and at all times, so that plants and animals cannot live there, as Ptolemy teaches in his book on the Arrangement of the Sphere. But if along with the longer pyramids we should add the authority of Aristotle in his second book on Plants saying that "among those where the days are prolonged," etc., and that is, as the commentator explains in regard to this word, where the day is half a year, and the night is half a year, there are neither animals nor plants, because the heat burns up their matter; it will appear that those places beneath the poles are uninhabitable because of the heat, not on account of the cold. For without doubt the day is half a year there, and then it would seem that the heat would be too abundant, while the sun enters the first degree of Aries, until he comes to the first degree of Libra, and this is through half a year. And there is the added fact that the dawn begins for a month and a half before the rising of the sun above the earth, and the twilight lasts for a month and a half beyond the setting of the sun, so that the light of the sun appears above the earth before the rising and setting through the whole time mentioned, just as for us in summer the light of the sun appears after its setting and in the dawn; wherefore because of the length of the twilight and of the dawn the heat will be greatly increased, since they do not have absolute night except through three months of the year, as is certain on the authority of all authors and men of science. Likewise the sun never leaves those parts, except through its greatest declination, which is about twenty-four degrees, because the equinoctial is the horizon of those parts.

But the sun recedes from us through a double declination, namely, forty-eight degrees. Therefore from a proximity of this kind the heat will be increased. Wherefore we conclude in accordance with truth that the localities there are uninhabitable because of the heat. But when Pliny in his Natural History and Martianus in his description of the regions of the world found by certain experience that the regions beneath the poles are the most temperate in this world, as they themselves state, and they allege the experience of men who were there, we cannot deny that the regions there are the most temperate; and who will bring into accord so great a contradiction? Surely no one, unless he be well acquainted with the principles of the multiplication and action of species. Therefore I present an argument for this view that naturally in accordance with its location in regard to the heavens and the sun the place is of necessity uninhabitable because of the cold; and very many authorities agree in this view.

But because of the accidental formation of the locality together with some natural causes, it is possible that some part of this region is consumed with heat, and another part is temperate. For because of the reasons derived from the longer pyramids, and because of the length of the day, and of the twilight and dawn, and because of the fact that the sun recedes from those regions only by its greatest declination, if we add an accidental cause to these, perchance we shall find what we are seeking. For without doubt, according to the teaching of Pliny, Martianus, and others, very lofty mountains are near the fertile districts of the North, such as the Rhipean, Hyperborean, and other mountains, whose height is immense. Owing to their great height they are able to exclude the cold of the North, as is the case in the mountains of Italy near the districts which are between the sun and the mountains. And there is likewise the added fact that mountains are found of stone, and others, hardened into crystal and salt, as we see in many places of the world. These mountains have surfaces more polished and equal, for which reason a greater and better reflection can be produced from them than from rugged mountains. For from a polished, equal, and smooth surface a sensible reflection is made, as is evident in mirrors; and this is because the parts agree in a single action, and the species is not dissipated, but

returns intact as it came; but owing to the inequality of the surface of a rough body no part is in accord with another, but the more elevated part first reflects, and then the more depressed, and so the whole species is dissipated and does not come intact, for which reason we do not see by means of rough bodies but by smooth. The excellence, therefore, of reflection that can be found in certain localities about the poles because of the polished surfaces of mountains, is able to coöperate in generating heat along with the height of the mountains. And we must consider, further, that mountains have various shapes, for one can have a shape like a burning mirror, and another like a spherical mirror, or a column-shaped, or pyramidal one, and where the shape of a burning glass is found together with other causes of heat, there must of necessity be strong combustion, so that nothing can live there, and in this sense is Aristotle to be understood with his commentator. Where, moreover, the causes of heat and cold are tempered in respect to the height of mountains, the smoothness of their surfaces, and their shape, the locality of necessity is temperate, and so are Pliny and Martianus and other experimenters to be understood.

Chapter IV

In which the complexion is investigated of the localities in the central portion of the world.*

The parts of the world in which we exist throughout the whole habitable portion up to the limit of the third climate are of bearable heat. Jerusalem is in the third climate, but beyond under the tropic of Cancer begins the torrid zone and the region unsuited for habitation. And because the path of the sun is between the two tropics, it is commonly thought that that whole region is hot and that no part of it is temperate; and this view is held because the sun twice in the course of a year passes over the heads of the inhabitants, and reaches the tropics only once, as at the summer solstice it comes to the tropic of Cancer, and at the winter solstice it arrives at the tropic of Capricorn.

* *I.e.*, the combination in a certain proportion of the qualities, *hot, cold, moist, dry.*

But in its passage from one to the other it passes twice over the equinoctial circle, namely, at the beginning of Aries and of Libra, and this happens at the beginning of spring and of autumn, for which reason many think that the region beneath the equinoctial is especially hot, and reasoning in accordance with the multiplications mentioned above support this view. For there twice at least in the year there are shorter pyramids and rays falling at right angles and perpendicularly, and consequently not refracted; and then they return upon themselves so that the rays are doubled, and therefore it seems on the first view that the whole strength of the whole natural action is there concurrent far more than elsewhere. But it is clear to us that beneath the tropics the Ethiopians are subject to the heat. Therefore it appears that the region beneath the equinoctial circle is the hottest of all; just as is commonly supposed. But without doubt Ptolemy maintains in the book before mentioned that that region is temperate in comparison with the tropics. And Avicenna teaches in the first book on Animals, and in the first book on the Art of Medicine that that region is the most temperate. And for this reason theologians maintain in these days, that paradise is situated there, and therefore the unlearned throng errs in respect to this place. We shall hold the view of Ptolemy at least, whatever may be the truth about the opinion of Avicenna and of the theologians, although the laws of the multiplication of species are here conclusive as far as they can be. But stronger causes are in opposition, which Avicenna excellently states, namely, that the declination of the sun is great there and the parallels are distinct and far separated. For while the total declination of the sun is about twenty-four degrees of colure, about twelve belong to the equinoctial signs, namely, Aries and Virgo, Libra and Pisces, and about eight belong to Taurus, Leo, Scorpio, and Aquarius, and about four belong to Gemini, Cancer, Sagittarius, and Capricornus. Therefore when the sun is in the signs where the declination is about four degrees, it advances, owing to the uniting of the parallels above this same region, for forty days, and burns as it does at the tropics. But less so in the other signs, where the declination is eight degrees, and least where it is twelve degrees, and this is about the equinoctial.

Another reason is due to the equality of day and night, be-

cause the air is tempered only during the night, so that there cannot be superfluous heat during the day, and for this reason there is in that region an equality in the air, and excellent arrangements of complexions, as Avicenna shows. There can be no doubt that the region is temperate, but whether it be the most temperate, I have not yet learned. And for this reason it is not settled whether paradise should be there. Since if the eccentricity of the sun is such as mathematicians maintain, it cannot be absolutely temperate beneath the equinoctial. For one part of the eccentric, which is called *oppositum augis* [perigee], descends to the earth by five parts of the semidiameter of the eccentric more than the remaining part, which is called *aux* [apogee]. And therefore when the sun arrives at the *oppositum augis,* it burns the earth in all ways, so that nothing can live there, on account of its nearness and the fall of the rays at right angles, and the uniting of the parallels, on which it delays above this same region, so that it burns it; and this happens when the sun is in Sagittarius and Capricornus and Scorpio. For the *oppositum augis* is in Sagittarius; and in regions near this sign the sun burns in the same manner and distempers. And therefore the sun will distemper Libra and Aries. For it has already passed through the middle portion of the eccentric when it arrives at the beginning of Libra, and has approached sufficiently the *oppositum augis,* so that it can cause an excessive amount of heat, as is clear in the figure. But it is agreed that paradise possesses an absolutely even temperature. But the proof of these matters does not belong to the present argument. And therefore I return to the proposition stating that the complexions of the localities of the world cannot be discovered unless a man knows the laws of the multiplications above stated, since he will neither avoid what is false, nor will he be able to prove what is true.

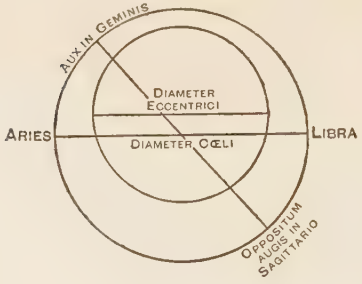


FIG. 13.

Chapter V

But place is the beginning of our existence, just as a father, as Porphyry says. And we see that all things vary according to different localities of the world not only in nature, but also men in their customs; since the Ethiopians have one set of customs, the Spaniards another, the Romans still another, and the Greeks yet another. For even the Picards, who are neighbors to the true Gauls, have such a difference in customs and language, that we cannot but wonder at such diversity in neighboring localities.

But since the objects of this world located in different places, however near they may be, receive the apexes of different pyramids coming from the whole heavens opposite to them, an infinite diversity happens on this account. For to the separate points of the earth come apexes of separate pyramids, and each point is the center of a new horizon. And therefore we see that two herbs grow out of the ground at the same time without anything in common, and for this reason twins in the womb of their mother receive by lot a difference in nature, so that afterwards they have different manners, and follow different arts and occupations through their whole life. And for this reason the forces of the heavens and stars produce everywhere different things in their properties and natures, and diversity in things generated according to propagation. And not only the multiplication of celestial force is operative, but that of father and mother, since forces are determined in the seeds, as physicians teach. Especially from the vital principle of the mother is there a continual multiplication of force and species over the foetus up to the completion of generation and birth. And when the child at birth is exposed to a new air, another world as it were, he then receives apexes of celestial pyramids as respects his separate members, and thus receives new impressions, which he never gives up, because what the new jug receives it tastes of when old. And then is formed the radical complexion, which remains to the end of life, although the current complexion may be changed for a whole day. And this radical complexion is followed by inclinations to morals and to sciences and languages, and to all the trades and occupations, and to all that diversity which we see in all things. And if the disposition of

the heavens is evil at the conception and nativity of the child, the apexes of the pyramids harm the complexion, and consequently the man is inclined to evil morals and perverse arts, according to the diversity of the celestial constellation: and if the constellation is good, the complexion is good, and there follows an inclination toward good morals and useful sciences; and if mediocrity happens in the celestial constellation, the man is mediocre in all things as far as his natural disposition is concerned, although he will be able to change himself through free will, God's grace, temptation of the devil, and good or bad counsel, especially in youth. And now what I have said in general can be proved, if there were time, by examples in individual cases. But concerning combustion made by crystal and glass and concave mirrors and other means visible to the eye, we are sensibly shown that refractions and reflections can produce natural effects. And it is well known that rainbows, comets, and many other impressions of fire in the air, and circles around the sun and moon are made by multiplications of this kind of rays, since they cannot have another cause. And the same is true of all other matters, although it is not evident in individual cases, because not of all agents are the species visible.

Chapter VI

In which is given the reason of the ebb and flow of the sea by means of rays.

And now I shall give an example hidden from all, and cite it in a case where it is less evident that a multiplication according to lines and determined angles is required—a matter as difficult as possible, which, however, is rendered sufficiently plain by means of the multiplication, I refer to the ebb and flow of the sea. Alpetragius in his book on Celestial Motions reasons that all bodies of the world except the earth are moved by the motion of the first heavens, and this is true; but in accordance with the fact that the farther bodies are removed the slower are they moved and with the greater hindrance. Hence water is moved more slowly and irregularly in its sphere than other bodies of the world. He accordingly adds that this motion produces the ebb and flow; but this explanation does not satisfy us in this

case, because the ebb and flow are determined and fixed, and they move as the moon varies in the parts of the heavens. But the motion of water is confused by the motion of the heavens, without order, and irregular, because the force of the first heavens is too far removed from its origin, when it is in the water, and therefore the proper force of the water prevails, namely, its own weight, because it strives to remain quiet in its own place, because this motion cannot be so regular and distinct at definite times as respects the ebb and flow as we see in the sea. And therefore Albumazar in the larger Introduction to Astronomy determines all the differences of ebb and flow, and states that they happen every day and night according as the moon is in the different parts of its circuit and with respect to the sun. But he does not tell us the reason, except that the moon is the cause, and that when the moon is in one place there is the flow, and when she is in another there is the ebb. Wherefore we must consider that when the moon rises over the sea of any region, its rays fall at oblique angles, as any one acquainted with the incidence of angles knows. And because they fall at such angles, the rays are necessarily of weak force, as has been shown before. And therefore they are only able to raise vapors from the depth of the sea, like swelling bottles, and overflowing waters of the sea, so that they are driven from their channels. These vapors the rays cannot draw out to the air nor consume them because of their weakness; and therefore of necessity the water flows from its resting places, as long as this kind of ebullition lasts. But when the moon approaches the middle of the sky, the rays fall more and more at right angles and become strong over the body of the sea and draw forth the vapors to the air and consume them, whence the flow grows weaker little by little according to the moon's approach to the meridian; and when she reaches it, the vapors are kept in check and consumed, so that at once while the moon is descending to another quarter of the heavens, the reflux begins, since the effect ceases when the cause ceases. And I shall give a sensible example for this. For in food placed above a fire the fire in the beginning resolves the vapors, and causes them to go forth by the mouth of the vessel; when, however, the fire becomes strong and its action continues, it consumes the vapors, and the liquor settles in the bottom of the vessel. For in general a weak heat resolves

vapors and does not consume them, for the strong heat of the sun consumes them, whence at night and in the morning and in the evening there is a greater resolution of vapors than at mid-day, and at that time they are consumed, and likewise natural heat after food and drink in the first place resolves the vapors vigorously and causes sleep. But when it has acquired strength for some time over the food it consumes the vapors, and the man awakes. For resolved vapors obstruct the paths of the spirits and of the heat coming to the senses from the heart and head, and therefore of necessity the senses become quiet and this is sleep. And such is the case with respect to every active force, whose property is to resolve and consume.

Albumazar states and others agree that the moon causes a similar effect in opposite quarters. For while the moon is in the quarter between the east and south the flood is in that quarter and in the opposite quarter, which is between the west and the angle of the earth. And while it is resolving the vapors when it is in the quarter between the angle of mid-heavens and the angle of the west, there is then a reflux likewise in the sea from the angle of the earth as far as the angle of the east. But these authors do not explain this matter, merely stating that the moon has a similar effect in opposite quarters. But how will the moon be active where she is not? And it is agreed that her rays do not pass through the middle of the earth. But in this matter the reflected multiplication aids us. For without doubt the starry heaven or ninth is dense throughout, for our vision continues to the second of these heavens, but vision is terminated only by something dense. At the second of the heavens the multiplied rays of the moon in one quarter are reflected to the opposite quarter, and so the force of the moon is direct in one quarter and its reflection at the same time is in the opposite quarter. But the force of the sun is excessively powerful, and therefore at whatever angles it falls, it is able to consume quickly the vapors that it resolves. But the force of other stars is weak because of their distance from the earth, although they are much larger than the moon, and because of this weakness they do not produce an effect of this kind, although their rays fall at different angles like those of the moon. I do not, however, understand that there is here an ebullition with intensity of heat as in a liquid over a fire, but there is a resemblance as far as regards

the resolution of vapors made by the force of the moon, either through rays of light, or rays of her own natural substance, or through both. For when during the night by the rays of the stars, and in the morning and in the evening by the sun there is a resolution of vapors from the earth and from the water, they do not on this account boil with heat, and yet they are raised up in very great volume and become clouds without number. And therefore it is not necessary that the waters of the sea should grow hot in the flow.

C. C. Riedel, C.S.V.

Chapter VII

In which the multiplication of forces is considered in reference to the health and the weakness of the human body.

Wonderful, therefore, is the power of this multiplication, since all things hidden and revealed happen in accordance with its laws. And a knowledge of these matters is not only necessary in the sciences, but affords us many advantages in body and soul, if we diligently investigate them, for it is very useful to know these laws in the conservation of health. For since we cannot avoid all impacts of species and forces of things evil and injurious to health, nor are we able always to adapt our bodies to meet more fully the forces coming from things conducive to health, yet we should always be anxious to receive not the principal forces of harmful things, namely, those refracted and reflected in straight lines, but the accidental ones if we can, and if we are unable to avoid all the principal forces, at least let us avoid those in straight lines, let us evade the fall at right angles, and, if we cannot, at least let us beware of the shorter rays of the pyramid. And these considerations have place when a man is exposed to harmful celestial impressions, like the sun in summer and the moon at night, which exhaust our bodies. Hence many have died from not protecting themselves from the rays of the moon. And especially is this true when a man is exposed to the rays of Saturn and of Mars, since those two induce much hurt and corruption in things, as experience teaches. Likewise the species from corrupt and unclean places, and when the species are multiplied of the leprous and of the infirm and especially of those with contagious dis-

eases, and of those with bad complexions, and particularly of a menstruous woman; since if she looks in a new mirror, a bloody cloud appears in the mirror from the force of the menstruation staining it, as Aristotle states in his second book on Sleep and Waking, and likewise from serpents and other venomous things. And especially must this fact be considered when men and animals become angry, and have the desire to do harm and a mind of malignity. For witchcraft is reduced to this source, whence what force it possesses it receives from this cause, since without doubt impression then becomes stronger, because nature obeys the thoughts and the desire of the soul, and she is aroused to stronger action, as Avicenna teaches in the eighth book on Animals and in the fourth on the Soul by examples and various experiences, and this is an assured fact. Whence Solinus tells us in his book on the Wonders of the World that in a certain northern region there are women with two pupils in the eyes, who on becoming angry kill people with sight alone, of whom Ovid says the double pupil does the harm. And we must be especially careful lest the noble parts, as the eyes and the face, be exposed to species of this kind: for I saw a physician made blind while he was endeavoring to cure a patient with a disease of the eyes, because of the multiplication of the species coming from the eyes of the patient. For it is necessary in the case of those harmful species to use great precautions, and especially so when the evil is severe or intolerable. So Alexander, instructed by Aristotle, as the histories state, by means of large polished bodies bent back upon a city the poisonous species of a basilisk placed on the wall to slay the army, so that it was destroyed by its own venom. And on the contrary the adapting of the body to receive the species of things conducive to health, as far as one can do so efficaciously, is very beneficial to both the healthy and the infirm.

Chapter VIII

Concerning the infinity of matter.

Since I have continued for too long a time my argument to show how in the things of the world as regards their efficient and generating causes nothing can be known without the power

of geometry, I now wish briefly to consider them with respect to their matter, by showing that it is necessary to verify the matter of the world by demonstrations set forth in geometrical lines, if we wish effectively to purge away numberless errors. For the majority of those philosophizing, not only in philosophy proper, but in theology, state and assert that matter is of one kind only in all things and that there is only diversity as respects their forms.

And they argue to prove this that if we should exclude by the intellect from the matter of the heavens and of a stone their forms, we cannot state by what they differ, because actuality, that is, form, distinguishes, as Aristotle says in the seventh book of the Metaphysics. And in the first book of the Physics he says that all things are one in matter but differ in form: and in the second book of the Metaphysics he says that there is no distinction in matter. And if matter were multifarious like form, he says that it must be common and predicable of more than one thing like form. And they allege that every universal has the nature of form. For the parts of definition, as Aristotle says in the seventh book of Metaphysics, are forms: but the parts of definition are through the genus and difference and compose species: therefore species is form only like genus and difference. And it is evident that the remaining two universals of Porphyry, that is, property and accident, are pure forms, because they belong to the categories of accidents. Therefore every universal is form; and for this reason matter will not have the nature of the universal but must be singular and the same in all things. By such fundamentals and authorities badly translated they strive to persuade us. But this is a very grave error. For there is no greater one in speculative truths, because this being granted it is impossible to keep the generation of things, and the whole course of nature will be unknown. But what is more, if this error be discussed, it will be found to be very close to heresy, or wholly heretical, than which nothing is more profane, because the necessary consequence is that matter is God and creator. This I wish to show for the present only by means of geometrical reasonings, as I promised, although reasonings from nature and metaphysics are abundant and efficacious, concerning which elsewhere a long disquisition can be made. And

it is necessary because of popular prejudice, which is violent everywhere.

I say, therefore, that if matter can be the same in two substances, by the same reasoning it can be the same in three and in an infinite number. For Aristotle makes a similar argument in the chapter on vacuum in the fourth book of the Physics, saying that if any one and the same thing can be in two substances, then it can be in three, and so in an infinite number; but that which can exist in an infinite number of substances has infinite power. Therefore matter is of infinite power. Wherefore also of infinite essence, as will be proved, and therefore it must be God. But they cannot contradict the aforementioned consequence, namely, that it follows that the same matter can exist in an infinite number of substances if they were existent, and therefore, they grant to it infinite power but deny to it infinitude of essence, because nothing has infinite essence, since nothing has infinite essence except God. And when they are hard pressed as regards infinitude of power, they begin to vacillate in their words, saying that the power of matter is infinite just like the power of continuous quantity. But this argument amounts to nothing, because this power of continuous quantity is not with respect to an infinite actuality, nor with respect to an infinite number of objects to be considered at the same time and in actuality, and therefore this power is not infinite in actuality but in potentiality only. But infinite power is so far granted to matter according to the position stated, that if there were in actuality an infinite number of things, the same matter could actually exist in those infinite things. Therefore it has infinite power, actually and intensively. But the power of continuous quantity is not similar to divine power: because divine power does not have confinement and limitation as far as regards actual existence in several objects and in an infinite number. To such existence the power of continuous quantity does not extend, but to matter there is conceded that same existence in several substances and in an infinite number by the authority and demonstration of Aristotle. Wherefore the power of matter is not like the power of continuous quantity, but like the divine power.

But they vacillate in still another particular, saying that the power of matter is passive, and the divine power is active. For

this is excluded in many ways. For passive power is spoken of with respect to a change suffered by an agent. But the power of existing in several substances does not come under this head, and so they differ. Likewise the power of existing in several substances at the same time, which is not confined or limited, is claimed for the highest excellence, and therefore is granted to God and to the soul, which as a whole is in many parts of the body. But we do not concede this quality to God and to the soul because of any passive essence, and therefore we do not concede it to matter. Likewise whatsoever this power be, whether active or passive, the substance of matter must be infinite if this power is infinite, and if this be true, then matter is God or equal to God, because no thing has infinite substance and power except God.

Let therefore the line A be infinite power and let the line B be its infinite substance, and let the line C be some finite power,

A *Potentia infinita*
B *Substantia ejus finita*
C *Potentia finita pars ipsius A*
D *Substantia potentiae C*
E *Substantia aequalis ipsi B substantiae*
F *Potentia proportionalis ipsi E*
G *Potentia major quam F*

which is part of infinite power (for from every given quantity it is possible by the intellect to remove a part, as Aristotle maintains in the first book of the Heavens and the World), and let line D be the substance of power C; let substance D therefore be multiplied until it becomes equal to B, for this is possible, since D and B are finite, and let the line E be this augmented substance. Likewise let the power C be multiplied to the extent that the power may increase proportional to E and let it be the line F, for this is possible, since C and D are finite, and therefore addition can be made to both to the extent that augmented they shall be proportional, just like C and D. But power F is finite, because it is the result of a finite augmentation and has a substance E equal to substance B, to which A corresponds, which is an infinite power; therefore the finite power F and the infinite power A must have equal substances. Wherefore the finite and the infinite must be equal, because equal powers be-

long to equal substances, and the part must equal the whole, since F is part of A, just as C is, as this assumption was made in the beginning concerning C, and F increases in accordance with the finite augmentation of C, wherefore F must be part of A, and thus the part must equal the whole.

From this we must conclude further that the part must have greater essence and more essence than the whole. For some finite power greater than F may be taken, and may be cut from the infinite power A, and let it be represented by the line G. Therefore the power G, since it is greater than F, must have more substance or be based on a greater and nobler essence than the basis of power F. But F had an essence equal to A, as was proved. Therefore G must have a greater essence than A; and thus to the part there corresponds more essence and a nobler one than to the whole, which is impossible. And it must also follow that the finite will have more essence corresponding to it than the infinite; and all these conclusions are impossible.

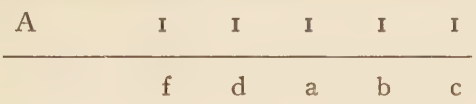
Likewise nothing infinite can have finite power. Therefore, on the contrary, nothing finite can have infinite power. The first statement is proved by a demonstration like the preceding one, for let the line *a* represent that infinite substance, and line *b* that finite power. Let some finite substance or part of *a* itself

a *Substantia infinita*
b *Potentia finita*
c *Substantia finita pars ipsius a*
d *Potentia ipsius c*
e *Potentia aequalis ipsi b potentiae*
f *Substantia potentiae e*

be taken and let it be the line *c*. Therefore it must have a less power; and let line *d* represent its power. Let therefore *d* be multiplied until it equals *b,* which is possible because both are finite; and therefore so much can be added to *d,* that augmented it may equal the power *b;* and let line *e* be that augmented power. In like manner then let *c* be multiplied and addition be made to it until it has the power *e,* and let that augmented substance be the line *f;* for this is quite possible, since substance *c* and *d,* its power, are finite, and therefore if to *d* so much can be added that power *e* becomes greater than *d,* to *c* so much substance can be added that the augmented substance will in-

crease, to which the power *e* will be proportional, and that augmented substance must have that power. But power *e* is equal to power *b*, as has been proved. Therefore *f*, which is finite, because it is produced in accordance with the augmentation of a finite substance by a finite factor, must have a power equal to *a*, which is infinite. This conclusion is clearly altogether impossible, and it must follow from it that the part equals the whole, namely, *f* equals *a*, and also that the part is greater than the whole, as was clear in the former reasoning; and that the finite has greater power than the infinite, as is clear in the terms, and all these conclusions are impossible.

Likewise if the power of matter is infinite let this power be designated by the infinite line A, and if this be divided at the point *a*, then the divided parts are equal, since both parts extend to infinity from the point *a*. Let then the point *b* be marked, likewise *c* and *d*. Then the parts divided are equal, but *baf* extending to infinity is greater than *af* by *ab*. Therefore line *bc* extended to infinity is greater than *af*. Therefore it is greater



than the equal of *af*, that is *abc*. Therefore the part is greater than its whole. Wherefore it is impossible for the power of matter to be infinite. We must not apply this demonstration to divine power, because it is not divisible like the power of bodily matter.

Chapter IX

Whether bodies touch each other in a point.

Just as I have employed the fundamental principles by way of proof to examples of things in nature, so likewise can some examples be noted that apply to the matter in the things of the world, in which the wonderful power of geometry shines forth. For if the matter of the world were of one kind, of necessity there would be but one form, and all things would be one body, just as Parmenides and Melissus have maintained, opposed to whom is Aristotle in the first book of the Physics and in the

book on Generation. For surely from a unity of matter there follows that most false power, which I previously eliminated by the laws of refractions.

Since, moreover, there are false geometrical illustrations in support of this position, which may disturb every man, I wish therefore to introduce certain ones. For if bodies are different in this world, like the heavens and an element, and we imagine a line passing through their middle, they will not cut that line in different points, because there would then be a linear length in the middle, and so a superficial width and a corporeal depth, and so there would be a third body distinct from the heavens and the element between them, which is false. Therefore they must cut that line in the same point. But those are continuous quantities whose terminus is the same. Therefore they are continuous. Many very illustrious men have given various answers to this question, and all gave their adherence to this point of view that they would cut the line in different points, either naturally or mathematically, or in both ways, making a distinction between natural and mathematical continuity in accordance with Averroës in the fifth book of the Physics. But this view is untenable; for the lines must necessarily intersect each other in the same point, so that an iron rod may be imagined; but that point does not continue the cutting bodies, and therefore they are not continuous, but continues the parts of the rod or line passing through, from the continuity of which it cannot be concluded that the bodies are continuous through which the rod passes; but if we should admit a cutting of the rod in different points, then of necessity a part of the rod, which part is a body, would be between; and this is impossible. Likewise it may be argued with more subtility that above as below any bodies assumed in this world, if they are different and contiguous, not continuous, a third body may be placed, to which at equal distance apart two lines may be drawn from the midpoints of the given bodies. If, therefore, those lines terminate at different points in the third body, then a part of that body is between them, and they are always equally distant and approach, and in the direction between the two bodies they will be distant by the body interposed, which is wholly false. Therefore they will continue to one point in the third body, and by the same reasoning to their own extremities at the junction of

the assumed bodies, wherefore the assumed bodies will be one body, because one point cannot be in different bodies. And many have been confused by this, nor is there time to review their individual opinions, especially since the truth is evident. If it be said that those lines will terminate at the same point of the body nor would they be parallel, because they have no distance between them, since the bodies are placed together without space between, and since all separation is removed, they must necessarily terminate at one point in the third body, and since two points do not have any length, since they are not quantities, therefore they do not occupy any more space than one point. Hence two consecutive points indicate as much indivisibility as one point taken by itself, because a quantity does not increase by adding point to point, and therefore they can remain different points at the extremities of two lines united in two bodies without space between, although they terminate at one point in a third body. But if in those united bodies two lines be drawn from these points within the bodies, and a line let fall upon their extremities at right angles, by the fourteenth proposition of the first book of the Elements of Euclid the lines extended in the bodies are one continuous line. Therefore the bodies also in like manner, for such is the purport of that proposition.

And because of this proposition Averroës was deceived in the fifth book of the Physics, and all those following him, maintaining that there would be one line mathematically, and consequently that there would be one body mathematically, although they would be different physically. For, as he states there, physical contiguity passes into mathematical continuity; but this is impossible, for a mathematical quantity and a physical one are the same as regards being and as regards reality, but they differ only in the point of view, because the geometer considers a physical line, not as it exists in physical matter, and therefore the line is called a mathematical one. And the natural philosopher considers this same line, as it exists in physical matter, as in iron, or stone, or other physical object. And because the same thing is, as respects being and reality of existence, physical and mathematical, therefore if there should be here one line or one body mathematically, then in the same way would there be one physically. I say, therefore, that there are here lines in reality different and bodies likewise, nor is

this statement at variance with the meaning of Euclid. For he does not mean that it is one continuous line, but that as far as making right angles the two lines are as effective as one, since those two lines lie in the same direction of length, just as if they were two parts of the same continuous line: and he has this meaning in many other places where he uses one line for two, since the one does the same thing for his proposition as the two. And this is the case when he speaks of a common difference of surfaces or of a common cutting, for he calls this one line when in reality there are two: but the one line has the function of these two, and therefore we speak more easily of one than of two.

If, however, the objection be raised that if one maintains a separability in bodies, two tablets of plane surface and of circular shape may be taken, and one raised from the other with a simultaneous action throughout the whole surface, and then the air would fill the outer portions more rapidly than the inner. For this reason there would be a vacuum in the inner portion for a time. And in regard to this matter many foolish statements were generally made. For some said that the air moved to the center instantaneously in accordance with a law of universal nature that there should be no vacuum; others said that all bodies touching each other in air or water have moist surfaces, as Aristotle states in the second book on the Soul, and they maintained that this moisture of air or water is rarefied suddenly throughout the whole, in order that there might be no vacuum. But their statement, that there may be no vacuum, is pure negation. No pure negation is a reason of an affirmation; and therefore answers of this kind are false. For this reason we must say that one plane cannot be raised from the other with a simultaneous action throughout the whole surface, but of necessity one tilts when it is raised from the other, and so the air penetrates gradually. Any one can experiment with this plane in a glass cup immersed in a vessel full of water; for it cannot possibly be raised keeping the same formation of its parts. The reason is that the water takes the place of it gradually. And this is an affirmative reason to which consequently vacuum is not admitted.

If, therefore, there are of necessity many corporeal materials and many bodies in this world, since every body is infinitely

divisible, it does not follow for this reason that the world is composed of an infinite number of material particles called atoms, as Democritus and Leucippus maintained, by whose position Aristotle and all students of nature have been more hindered than by any other error. Yet this error is wholly eliminated by the power of geometry; for no stronger argument can be used against this error than that the diagonal of the square in that case and its side would be commensurable, that is, would have a common measure, namely, some aliquot part as a common measure, the contrary to which Aristotle always teaches. And the truth is clear by the demonstration from the last part of the seventh proposition of the tenth book of the Elements, where it is shown that if some measure, as a foot or a palm, measures the side, it will not measure the diagonal, nor *vice versa;* so that if the diagonal is ten feet, the side cannot be expressed exactly in feet. And not only does it follow from this position that they would be commensurable, but also equal. For if the side has ten atoms, or twelve, or more, then let the same number of lines be drawn from those atoms to the same number in the opposite side, the sides of the square being equal; wherefore just so many lines will occupy the whole surface of the square; and therefore since the diagonal passes through those lines, and no more can be drawn in the square, the diagonal must receive a single atom from each line, and therefore there will not be more atoms in the diagonal than in the side, and thus they have an aliquot part as a common measure, and the side has just as many parts as the diagonal, both of which conclusions are impossible.

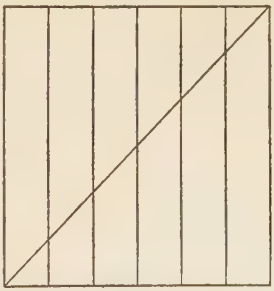


Fig. 14.

Chapter X

Concerning the shape of the universe.

Since of necessity the bodies of the universe are many and divisible and are quantities, they must have a form required

for the existence of the universe. Now form is a property of matter, and is found in things by reason of matter, just like quantity also. For figure in one aspect is quantity inclosed by lines; in another it is called the limitation of quantity. It is necessary, in fact, that the universe on the outside should have a spherical shape. For should any other form be given to it, there would be a vacuum or the possibility for it. But nature does not endure a vacuum nor a possibility in respect to it. For if it were of some angular form, then of necessity there would be a vacuum in its motion; for where at one moment there was an angle, there would be nothing until another angle came to the same place. Other figures especially suitable would be either of oval shape or those like it or of lenticular shape and those formed like it, according to Aristotle in his book on the Heavens and the World. But he states that the heavens do not have a shape of this kind, but he does not give a reason. A lenticular shape is that of the vegetable called lentil. For it has gibbous lateral surfaces, and is not a true sphere, owing to a shorter diameter passing through those sides. If the universe had the shape of an oval, cone, cylinder, or other figure of this kind, and revolved about the shorter diameter, there would actually be a vacuum; but if it revolved about the longer one, there would be no vacuum actually, but there would be the possibility of a vacuum, since there would be just as great a possibility, as far as the figure is concerned, that it would revolve about the shorter diameter as about the longer. If, however, it were of lenticular shape or of the form of a cheese or of similar shape, and moved about the longer diameter, there would actually be a vacuum, and if about the shorter, there would not actually be a vacuum, but the possibility of it would remain. For it is just as possible as a matter of fact that it should revolve about one diameter as the other. Nor can we say that if it were oval in shape it would revolve always about the longer diameter, and if it were lenticular it would revolve about the shorter, in order that there might be no vacuum. We must refute that statement just as we did above, namely, that it is impossible that a pure negation should be the cause of an affirmation; but the statement, that there may be no vacuum is a pure negation. Therefore the universe must be of spherical form, in which solid alone are all diameters equal, so that it can revolve freely on every

diameter, and thus no inconvenience results. Likewise within it must be spherical and concave; for it cannot be of a plane figure. Since if three lines be drawn from the center of the earth, and one perpendicular to the surface of the heavens, as *ab,* this last line will be shorter than the others by the eighteenth proposition of the first book of the Elements and the thirty-second proposition of the same book. Therefore the heavens will not be equally distant from the earth: but it must be of the same nature in every part. Therefore every part is naturally equally distant from the earth. Nor can it be convex looked at from within, as

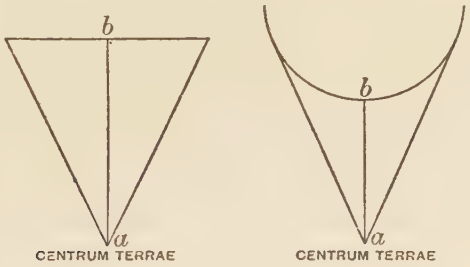


FIG. 15.

is shown by the eighth proposition of the third book, which states that from a point taken without if many lines are drawn to a circle, the line falling on the diameter would be shorter than the others. Therefore it remains that if from the center of the earth three lines be drawn to the convexity of the heavens, one will be shorter, namely, that one which is perpendicular to the sphere, as is clear in the figure, and therefore the heavens would not be equally distant from the earth, which, however, it must be, as has been stated. And again if the universe were of convex figure looked at from within it would not naturally contain all things; but the universe does naturally contain all things. But if it cannot be of a plane figure nor of a convex, it must be concave, since there is no other shape. But it can be concave in many ways, either spherical, or cylindrical, or pyramidal, or lenticular, or of many other shapes. It is not possible, however, that it should have any other concavity than a spherical one, because in this figure alone are all the lines equal which

are drawn from a point to the surface. For it is not possible in other figures to take a point from which all lines drawn to the surface may be equal: for the diameters are unequal. But the parts of the heavens must be equally distant from the earth on account of the equality of nature. Therefore of necessity it must be of spherical form.

Moreover, among all isoperimetric figures the sphere has the greatest content, as the eighth proposition of the book on Isoperimeters states. Plane figures are called isoperimetric, as the triangle, quadrangle, and circle, when the sides of the triangle extended continuously and in a straight line have the same length as the four sides of the quadrangle when so extended, and the same length as the circumference of the circle if it were extended, and the same thing is true of all other plane figures. Whence the word isoperimeter is formed from ἴσον, equal, περί, around, and μετρόν, measure, meaning, as it were, of equal circummensuration. And among all these isoperimetric surfaces the circle is the maximum, as the seventh proposition on isoperimeters states. Solids, moreover, are called isoperimetric; as the sphere, cube, cylinder, and any other, when the surface of the sphere extended continuously and in the same plane contains as much in length and width as the six surfaces of the cube and as much as the surface of the cylinder, and so of the others. But among all those figures the sphere has the maximum content, as is demonstrated in the book mentioned above. Since, therefore, the heavens must contain all things, it was necessary that it should be of spherical form. Likewise the nobleness of the universe and the excellence of this figure correspond. For this figure is the first of the solid figures, because it is contained in a single surface, while all the others have more. Therefore it is adapted to the first body, the heavens. Moreover, this figure is the simplest, since it is without angles, vertex, sides, and free from every difference. Therefore it belongs to the simplest body, namely, the heavens. It is likewise most fitted for motion. Therefore it belongs to the *primum mobile*. It is likewise removed from chances and hindrances, because it has no angle against which something might strike. Therefore it is especially fitted for a body that cannot have hindrance or chance of accident. It is, moreover, the most perfect, because nothing can be added to it; but to all others some-

thing can be added. Therefore it belongs to the most perfect body.

The fact, moreover, that the bodies contained in the heavens should have a spherical shape, is proved from water, which lies in the middle, so that it is consequently evident as regards the others. If lines be drawn everywhere to the surface of the water from the center of the earth, it is plain that water always runs to a lower place because of its weight, as we see. Therefore if one of those lines should be shorter than another, the water would run to the extremity of that line until equality was established. Therefore all lines drawn in every direction from the center of the world to the surface of the water are necessarily equal. But lines so drawn to a plane cannot be equal, by the eighteenth and thirty-second propositions of the first book of the Elements, as was stated above, nor can they be equal when drawn to a convex surface by the eighth proposition of the third book. Therefore of necessity the surface of the water containing the earth must be concave, and not of any other kind of concavity than that of the sphere, since in that figure alone are all the diameters equal. And this demonstration holds with regard to the water, not only as viewed from within but as well as from without. For on the outside it flows always to a lower place as well as on the inside. And therefore the water must be convex on the outside, for neither to a plane nor to a concave figure on the outside could all lines drawn from the center be equal, according to the form of the previous demonstration, and this is shown by experiment.

For let *gd* be a ship, and *a* a port, and *c* the deck of the ship where the mast is fastened, and *b* the end of the mast, and let the line *ca* be drawn perpendicular from the port to the end of the mast. It is then plain by the nineteenth and eighteenth propositions of the first book of the Elements that line *ab* is longer than *ca*. Therefore if the sea were plane-shaped, the eye at *c* would see the port better than at *b*, since *b* is more distant from *a* than *c*. But we know by experience that he who is at the top of the mast can see the port more quickly than a man on the deck of the ship. Therefore it remains that

Fig. 16.

something hinders the vision of the man on the deck of the ship. But there can be nothing except the swelling of the sphere of water. Therefore the water is of spherical form. But if this is true, then the earth is of convex spherical figure, for otherwise it would not be equally distant from the heavens, nor would it be equally near the center of the universe; but this must be the case. Likewise there would be a vacuum where they did not touch each other: since if it were a plane or of a concave shape it would not touch the concavity of the water, as is evident, and therefore there would be a vacuum between them.

In a similar way we must proceed in regard to the sphericity of the air concave within and to its sphericity on the outside, as we did in the first demonstration in regard to the water; because the air is heavy in its sphere like the water, as we maintained previously, and therefore it flows to a lower place. And, moreover, there would be a vacuum between the air and the water, if the air were of another shape. For if it were a plane, it would not touch the water except in a point, by the third proposition of the first book of Theodosius; because a sphere does not touch a plane except in a point, as is there stated. If, however, it were of a convex shape, it likewise would not touch except in a point by the twelfth proposition of the third book of Euclid. For if two circles are marked on the convex sphere of water and on the convex air, the circles will not touch each other except in a single point, as is proved in that twelfth proposition. Therefore the same is true of the bodies on which the circles are marked; for if the bodies touched each other in many places, so also would the circles, as is clear to the sense. And so of necessity in either way there would be a vacuum. And if it were of a concavity different from that of the sphere, not all lines could be drawn equal from a point to the surface. Therefore of necessity the surface of the air must be spherical within and without.

Then by these last demonstrations the same fact is evident with respect to the fire as well as the air. But the proof relating to the descent to a lower place does not hold here, because fire is not heavy in its sphere. Nevertheless, it is necessary that all lines drawn from the center of the world to the surface of the fire should be equal, because fire is opposite to the earth and of the utmost lightness, and of the same nature in the whole

and in the separate parts. Wherefore it is equally distant from the locality of things with weight, and from the center of the world, and this is true both as it is as viewed from without and from within. Therefore it must be concave within, and convex without, and spherical in form, as we conclude from the arguments given.

Chapter XI

That a vessel placed in a low position contains more water than one in a higher position.

But now as regards the form of the water a great wonder of nature can be noted; since if a cup containing water be put in a low place, it will be able to contain more water than in a higher place, as in a cellar and on a balcony. For on account of the natural inclination of the water to the center of the world, wherever the water may be, either in a higher or lower place, its portions always run to the lower place; and therefore they are always distant from the center by equal lines; and therefore the higher part of the water must be a portion of a sphere described around the center of the world, although in the bottom of the cup the water retains the shape of the vessel, because there only does it touch the vessel and not above. This top part will be shaped according to the law of the gravity of water, and this holds with respect to the center of the world, and therefore the upper part will be a portion of a sphere to be conceived of as around the center of the world. But it is evident that in a lower position it will be a portion of a smaller sphere and in a higher position it will be a portion of a larger sphere, because it will then be more distant from the center; for the higher sphere will contain the lower one, as is evident around the same center. Moreover, the diameter of the cup will be a chord of both portions, if the cup be filled in both cases to its full capacity. Therefore that diameter will cut from the larger sphere a smaller portion, and from the smaller sphere a larger portion. By the twenty-eighth proposition in Jordan's Triangles, in unequal circles the same chord cuts from the larger circle the smaller portion, and from the smaller circle the larger portion, and the same is true of spheres.

For let those circles be marked on those spheres, and the portions of the circles on the portions of the spheres, and it is evident that the result is the same. Therefore the portion of water above the diameter of the cup will be greater when the vessel is in the lower position than when it is in the higher; and therefore the gibbosity is greater and the swelling higher; wherefore there must be more water there, if the cup is completely filled, than in the higher position. Wherefore to the same water more can be poured into the cup when it is lower than when it is higher. For in the lower position the water which is above the diameter of the cup will contract from the sides of the vessel, and will narrow itself into the portion of the smaller sphere, because it is nearer the center of the world, and therefore the chord of the same water will be less than when it was above. And a part of the diameter of the cup will be its chord, not the whole diameter, but on both sides a part of the diameter will be cut off, so that the part left becomes the chord of the portion of water. Wherefore at the sides of the water from the point where the diameter is cut up to the vessel there will be two small spaces where it will be possible to pour in more water than when the cup is in the higher position. This whole phenomenon is due to the inclination of the water following the law of its gravity to form itself into a smaller and larger sphere with respect to the center of the earth; notwithstanding the fact that this seems utterly impossible to the rank and file of students, nay, to great men ignorant of the power of geometry.

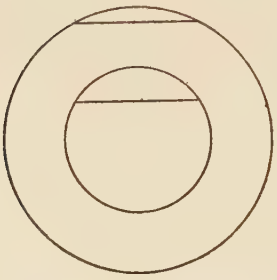


Fig. 17.

Chapter XII

Whether the five figures of the regular solids correspond to the world as the Platonic school maintained.

In consequence of the spherical forms of the bodies of the universe a firm basis is disclosed in the proof of the things of nature, and violent errors are purged away. For the Platonists, in

whose time geometry flourished, as Averroës states in the third book on the Heavens and the World, thought that the principal bodies of the world, namely, the heavens and the four elements, had the shapes of the five solid figures called regular, which are equiangular and equilateral, and can be inscribed in a sphere and circumscribed about the same, and there are no others. And for these reasons they are the noblest of figures, with the exception of the sphere, which the author of the present work can easily describe. Three are formed with triangular surfaces, the fourth with square surfaces, and the fifth with pentagonal surfaces; and there cannot be more than these, a fact to be marveled at. The first has four triangular surfaces, and is called a tetrahedron, from τετράς, four, or pyramid of four triangular bases. The second has eight triangular surfaces, and is therefore called octahedron, for *octo* is pure Greek, not Latin. The third has twenty triangular surfaces, and is called icosahedron, from εἴκοσι, twenty. And no more regular figures can be formed with triangular bases. For no angle of a solid can equal four right angles in a plane, as the twenty-first proposition of the eleventh book of the Elements teaches. But six angles of equiangular triangles are equal to four right angles: for three equal two right angles, as is evident from the thirty-second proposition of the first book, which is well known. And therefore six angles of the triangles cannot form an angle of a solid; and therefore a solid figure cannot be formed with triangular surfaces of which the six angles meet to form an angle of the solid. But a solid can easily be formed, because the sum of five, four, or three angles of the triangles is less than four right angles. And if three angles of the triangles form an angle of a solid, it must then have four triangular surfaces. And if four angles of the triangles form an angle of a solid, there must be eight triangles in the solid. But if five angles of the triangles form an angle of a solid, there must be in the solid twenty surfaces triangular on all sides, as is evident to the sense in solid figures. Moreover, from two angles in a plane an angle of a solid cannot be formed, because every angle of this kind is formed from at least three surfaces, as Euclid states in the beginning of the eleventh book; and every geometrician knows this fact. Therefore only three regular solids can be formed from triangles. From squares only one can be

formed; for the angle of a square is a right angle, and therefore only three such angles placed together can form the angle of a solid, because if a fourth be added no longer is the angle of a solid possible, because every angle of a solid is less than four right angles. But if three angles of squares are concurrent to form an angle of a solid, in the solid so formed there will be six square surfaces, as in the taxillum; and this figure is called cube and hexahedron, from ἕξ in Greek, which is *sex* in Latin. But if the angles of regular pentagons are taken, three form an angle of a solid, and no more, because if four be taken, the sum would be more than four right angles, since the angle of a pentagon is one and one-fifth right angles, as is evident from the thirty-second proposition of the first book of the Elements, and so there would be four and four-fifths right angles. But every angle of a solid is less than four right angles. Therefore there can be only one solid with pentagonal surfaces, and it must have twelve pentagonal surfaces, as is evident in the formation of that body, and it is called dodecahedron, that is, a solid figure of twelve bases of equilateral pentagons.

All these regular solids are formed with regular surfaces which are equiangular and equilateral. It is not possible to form a regular solid with hexagonal surfaces, because the angle of a hexagon equals one and one-third right angles, as is evident from the thirty-second proposition of the first book of the Elements. Therefore three such angles make three and three-thirds right angles, but three-thirds equal one whole unit. For there can be only three thirds in anything. Therefore the three angles of regular hexagons equal four right angles, but no angle of a solid equals four right angles. Therefore no regular solid can be formed with hexagonal surfaces, and far less with heptagonal and octagonal ones, or with surfaces having a still greater number of angles, because such figures have larger angles than those of the hexagon.

Since the dodecahedron permits all the others to be inscribed in it, as is evident from the fifteenth book of the Elements, the Platonists gave this shape to the parts of the heavens, because the heavens are known to contain all things. Whence they said that the parts of the heavens are concurrent in a point in accordance with this figure, so that the body of the heavens may be established. And because fire ascends in a pyramidal form,

they gave the parts of fire such a form. Since, moreover, the octahedron resembles very greatly the pyramid, and air is very much like fire, they give it that form. But since the parts of water revolve in numerous windings and fluxes, they gave it the form of the icosahedron, which in its many-formed sides and angles is whirled around in the sphere. To the parts of the earth they assigned the cube, because that figure is stable and fixed among all, as the earth among the bodies of the universe has obtained stability and fixedness.

But Aristotle opposes them in the third book of the Heavens and the World, and proves that with this formation there will be a vacuum in the sphere of water, in the sphere of air, and in the celestial sphere. For the cube and the pyramid alone are able to fill space, when they are assembled about a point. For it is possible to fill space in two ways; in one, as we commonly say, because every body fills space, unless there be an instance in the last heavens, and the filling of space is not taken thus in the proposition. In another manner space is said to be filled not only solidly but superficially, and more properly so because the fewness of surfaces filling their spaces is the cause of the fewness of solids filling their spaces, as Averroës states in his comment on the third book of the Heavens and the World. Now to fill out superficial space is to complete four right angles, because there cannot be more about a point in a surface, as is evident from the intersection of two lines at right angles in this way. And so squares most properly can fill superficial space, namely, four of them, because the angle of a square is a right angle; and six triangles, because angles of this kind equal four right angles, and three hexagons, because their three angles equal four right angles, as explained before. But pentagons cannot fill space, because three angles of pentagons are equal to three and three-fifths right angles, which in all is less than four right angles, and four angles of pentagons equal four and four-fifths right angles, which is more than four right angles and therefore this regular figure cannot fill space. Likewise neither the heptagon, nor any other, as is evident. And therefore only three surfaces fill space. And for this reason there will be few solids that can fill space solidly, and filling space solidly in this way is not done by a single body, but takes place when several bodies are grouped about a point on all sides, so that they fill a space

solidly about that point. And this space has eight solid angles, and twelve superficial right angles separate in point of fact, although there are twenty-four theoretically, since each solid angle is formed of three superficial ones, and therefore we have a total of thrice eight, or twenty-four. But some are frequently repeated, since these angles are united; for if they were divided, there would of necessity be twenty-four separate angles, as each solid angle distinct from another would have three right angles belonging to it. All these facts are evident from three lines intersecting one another at right angles, as in three rods or as in other examples. Since the angle of a cube is formed from three right angles, eight such can most properly fill the space about a point. And therefore in the sphere of the earth, according to the formation now stated, there will be no vacuum, because eight cubical parts of the earth placed together about the center of the world fill necessarily the whole space about that center. Now the angle of the pyramid is formed from three angles of triangles, wherefore it equals two right angles, and therefore six such angles equal four cubic angles, for on both sides they equal twelve right angles, and the other six equal the other four cubic angles. Wherefore Averroës concludes in the third book of the Heavens and the World that twelve angles of pyramids placed together about a point will fill the whole space solidly, just as do the eight angles of the cube, and therefore in the sphere of fire there is no vacuum. But other figures placed together about a point cannot, according to Averroës and Aristotle, fill space. For whatever number are placed together their sum will be greater or less than the eight angles of the cube, and therefore they will not fill space. Therefore in the sphere of water, and of earth, and of the heavens, there must be a vacuum, according to the form of the Platonists. As the cube in filling space solidly corresponds to the square in filling a surface, because the cube is formed from square surfaces, since both figures most properly fill space, so the pyramid corresponds to the regular triangle, because the pyramid is formed from triangles, and both figures fill space. But to the third figure, namely, the superficial hexagon, there is no corresponding solid figure filling space, because from superficial hexagons a regular hexagonal figure cannot be formed, as demonstrated before.

And yet the bee forms hexagonal houses that a vacuum may not exist between them; and nature in the womb of the earth forms crystals all hexagonal united into one. So also stones called irises, and said by authorities to be found in Ireland and India only, are formed together in a hexagonal shape. They are called the stone of iris, because they represent the colors of the iris and of the celestial bow, when they are exposed to the solar rays. The same is true of all things generated in this world which are united by their surfaces to retain hexagonal figures, that vacuum may be excluded, and this is a remarkable fact. But, however, there is no real filling of space as Aristotle uses the term in this place: for such filling of space is with respect to every position of solids and surfaces, as four taxilli superficially with respect to every position fill space, and eight fill space solidly, in whatever way angles or sides may be changed, for there is absolute equality in those angles and sides. And the same is true of pyramidal solids and of superficial triangles, squares, and hexagons. This property does not belong to other figures with respect to every position but with respect to some one position, and therefore it is not considered. For if to some houses erected by the bees others be added in another position, the space is not filled up, but there is a vacant space left, and therefore they do not belong to those figures that fill up space, so that the filling may be spoken of absolutely and without qualification. Because of the formation of things in nature the subject of these figures filling space is important and profound. But in general in regard to this formation in the principal bodies of the world I have told enough for the present.

Chapter XIII

Whether there can be more universes and whether the matter of the universe may be extended to infinity.

I pass further to two examples briefly to be noted in bodies in the universe—examples based on geometrical reasoning and connected, moreover, with the matter of these bodies. For Aristotle says in the first book of the Heavens and the World that the universe contains all of its own matter in one individual of

one species, which is true of any principal body in the universe, since the universe is one in number, nor can there be more universes in this species, just as there cannot be more suns or more moons, although many have maintained the contrary. For if there were another universe, it would be of spherical figure, like this one, and there cannot be distance between them, because in that case there would be a vacant space without a body between them, which is false. Therefore they must touch; but they cannot touch each other except in one point by the twelfth proposition of the third book of the Elements, as has already been shown by circles. Hence elsewhere than in that point there will be vacant space between them. There is another proof that the matter of the universe is not extended to infinity, as many have maintained. For geometrical reasoning excludes this. Let two lines *a* and *b* meet at an angle at the center of the universe, and from the point of meeting let them be extended to infinity, and let a third line be drawn parallel to one of these and let it be terminated at the other and let it be *ca*. Then *a* and *b* are equal, and *o* (which is part of *a*) and *c* are equal, because from the same point, namely, *o*, they extend to infinity. But line *c* equals line *b*. Therefore line *o* must equal the whole of *a*, that is, the part must be equal to the whole, which is impossible.

Chapter XIV

Concerning unity of time.

Many other geometrical proofs, moreover, might be adduced in addition, and other truths almost infinite in number might be cited in matters of the world, in which geometrical power is manifest. But these suffice for our argument, and I shall merely explode two fallacies which in accordance with popular notions follow upon the numerical unity of matter. For they maintain that time follows upon matter, and age upon form, and therefore as matter is one in number and not more, so time is one in number, and just as form varies in things, so the age is multiplied everlastingly. Hence there are said to be many ages, and unity of time, so that in accordance with the number of angels is the number of ages. But since it has been proved that matter cannot be one, it is false that time has its unity from the unity

of matter. Moreover, time can follow only its own subject. But motion is its subject, not matter; and the subject of motion is not matter, but body composed of matter and form.

Finally, geometrical considerations explain to us the cause of unity in time and furnish a proof respecting it. For a body, since it has on all sides dimensions, does not for this reason permit another body with it: for a body has everywhere that with which it excludes another body in length, breadth, and thickness. Therefore a surface in length and breadth will exclude another surface, but not in thickness, because in this respect it is indivisible and lacks dimension. A line in length excludes another line, but not in breadth and thickness, since it does not have these dimensions. Therefore a point, since it lacks all dimensions, has no means of excluding another point from its own indivisible position; but a first point having been conceived of in its own position, a second coming will have exactly the same position, because there is no distance between, and this is also true of a third point and of an infinite number. Motion, in fact, has only linear dimension from prior to posterior in length of space, and this is from past to future. Therefore only in this course, namely, from prior to posterior, or from past to future, will one motion exclude another; namely, prior will exclude posterior, and the past will exclude the future. But a comparison of motion in the present is different from that in its course from past to future. Therefore in respect to the present no motion has dimension nor divisibility, and therefore will not have the means of excluding another from the present. Therefore it can permit an infinite number to be present with it; and hence one present moment suffices for all present motions, and because of this fact this is considered the real reason of the unity of time, and not because of matter. Moreover, from these considerations can be established the real unity of the age as well as of time. For the age has assuredly only linear dimensions, if we should maintain that the age is divisible and has parts, as many think in opposition to the whole force of philosophy and in opposition to Augustine and Dionysius, although Anselm does not agree. If this be true, then the same reasoning applies to the age as to time; the age must be single and not multiple. Or the age will be indivisible, and in that case it will be perpetual, just like the indivisible position for

points and atoms, the same position being common to one point and to many, as we have shown.

Therefore there will be one age belonging to all ages. This is a necessary conclusion and doubted by no one skilled in philosophy. Nor is it opposed to the sacred writers and principal doctors, but is in agreement with their view.

Chapter XV

Whether the motion of heavy and light bodies excludes all strain, and how motion generates heat. Likewise concerning a twofold method of knowing the truth.

Since motion is the subject of time, and time is the measure of motion, we can now see the great force of geometry in the motions of the bodies of this world. Physicists consider that the motion of heavy bodies downward is altogether natural, and the motion of light bodies upward is likewise wholly natural, so that as a result they suffer no strain. But a geometrical figure shows us the contrary. For let *dbc* be a piece of wood or a stone in the air, *a* the center of the earth, and *gh* the diameter of the earth. Since then *dbc* are always equally distant in their own body, they will fall toward the center along parallel lines. Therefore *d* will fall along the line *de,* and *b* along the line *ba,* and *c* along the line *co,* wherefore *d* will fall outside the center of the earth on the diameter of the earth *hg* toward the heavens, namely, at the point *e,* and *c* at *o;* wherefore in this fall *d* will deviate from the center *a* toward the heavens by the height *ae,* and *e* by the height *ao.* But every deviation of a heavy body from the center toward the heavens is a strain. Therefore *d* and *e* are moved under a strain, and the same is true of all the parts of *dbc* except *b,* which alone falls to the center. Therefore there will be much strain here.

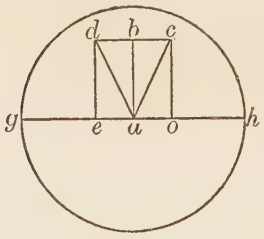


Fig. 18.

But the straight and natural path of *d* is along the line of *da,* whence if *d* be separated from its whole, it would fall to *a* by a straight path, because every heavy body tends toward the cen-

ter. Moreover, every deviation of a heavy body from the straight path is a strain, but the more *d* is moved along the line *de,* the more it departs from the straight path, as is clear to the perception, because the lines *da* and *de* are more widely separated below than above. Therefore the further *d* falls downward, the more is it moved under strain, and likewise *c* and each of the other parts of the whole weight *dbc,* except *b* which alone is always falling along the straight path. It is clear, therefore, that there is a great and complex strain in the natural motion of the heavy body itself. From this there follows a certain truth in nature, namely, that natural motion generates heat; for since the strain has been proved, and we are agreed that a heavy body's tendency is naturally downward, it is evident that there are two forces in a heavy body downward drawing it in opposite directions. Therefore one of these draws the parts of the heavy body in one direction, the other in another, and in consequence of these pulls the parts of the heavy body are of necessity rarefied. But rarefaction is an immediate disposition to heat, whence by experiment we know that a heavy body falling downward grows warm. Therefore we can state here, as in former cases, that the reasons of things in nature should be assigned by the power of mathematics. A man can see that in the things of nature there are two methods of proof, one by a demonstration that proceeds through the causes, and the other by a demonstration in regard to the effect, as in the demonstrations given it is proved by the cause that strain takes place in a heavy body in its own natural movement, later this same fact is demonstrated by the effect, namely, by the generation of heat. For heat would not be generated except through rarefaction, nor would that rarefaction take place except from forces drawing the heavy body in opposite directions, and these can only be the one natural, the other producing a strain, on account of which a heavy body in its own natural motion is under strain. Thus this conclusion, a heavy body receives a strain in its own natural motion, is proved by cause and effect. But cause alone produces knowledge far greater even than does effect, because Aristotle says in the first book of the Posteriores that we believe we know when we learn the causes. Therefore, when the proof, as he shows in the same book, is a syllogism causing us to know, the proof through cause is of necessity far stronger than that

through effect; and Aristotle maintains this in the book of the Posteriores. Wherefore when a proof is given through cause by means of mathematics, and a proof is given through effect by means of nature, the mathematician is more efficient in learning the things of nature than the natural philosopher. And this is particularly clear, that motion purely under strain, as the motion of a heavy body upward, will generate heat, and far more so than natural motion; because in a body moved under strain there are two altogether opposite motive forces, both in the whole body, and in opposite directions, as the natural force of a heavy body tends downward, and the force of strain tends altogether upward. Therefore there is a great difference in the parts of a thing moved under strain, and a greater one than in natural motion.

Chapter XVI

Concerning the movement of the scale.

In addition to what has been said already it is expedient to disclose further the potency of geometry in motions; and I purpose to do this because of a general understanding of the science of weights; a noble one and too difficult for men not acquainted with the causes relating to the motions of heavy and light bodies. Therefore Jordan says in his book on Weights that if a balance is in a horizontal position with equal weights in the scales, it will remain in this position; and if it is disturbed, it will return to the horizontal position. This we see sensibly in both scales, the beam of which is equal in length on both sides, and equal weights are in the pans, and the scale is held horizontally by the support, so that the support is at right angles above the beam of the balance at the center of revolution; for this point is called the center of revolution, from which the support extends at right angles. It is called the center of revolution, because when by the force of a hand depressing one of the equal weights, or owing to the inequality of the weights one of them is lowered, the other will be raised, and this motion of descending and rising will describe a circle of which that point from which the support extends is the center, and therefore it is called the center of revolution. To make

this clearer, let us draw a figure. For let the rod or beam of the balance be *ab* and let *cd* be the support, then the center of revolution from which the support extends will be *d,* and on the circumference of this circle the weights will move, for the descending one will describe the lower circle, and the rising one the upper circle. These assumptions being made, the proof is as follows. When one of the arms of the balance with equal weights is lowered by the hand of one depressing it, it becomes heavier, according to Aristotle in the fourth book of the Heavens and the World, because the lower a body sinks, the more weight it acquires, as he himself says. Therefore the descending weight becomes heavier, however little its descent from the position of equality may be, and therefore the greater its descent, the greater will be its weight. Therefore it will become unequal to the other weight and heavier than it. Therefore, although they were equal in the horizontal position, yet when they lose this position they become unequal in weight; wherefore the one which is depressed will always continue to descend, and the other will always ascend, and therefore they will never return to the horizontal position. Just so when two unequal weights are placed on the arms, they immediately lose the horizontal position, and will never return to the same position, but the heavier one always descends. So likewise in the case under consideration, which is contrary to Jordan and to our sense. Jordan likewise says that between any weights there is assumed in the same way a proportion of velocity in descent and of weight, but that the greater the descent of a weight, the heavier it becomes. Therefore it descends with so much greater velocity. Therefore it will never return naturally to the horizontal position. Jordan also says that one weight is less heavy as regards position, because it follows the descent of the other with an opposite motion, that is, because it ascends when the other descends, and *vice versa;* wherefore they will never come to rest in a position of equality. That, moreover, the weight which is depressed is less heavy in respect to position, is clear for this reason, because it takes a less direct descent on

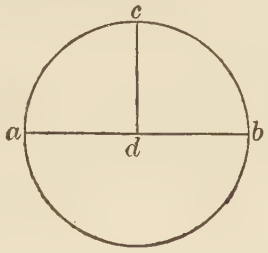


Fig. 19.

the diameter passing through the center of revolution toward the center of the earth; wherefore, according to Jordan, it will be less heavy according to position. This conclusion truth itself requires, as explained by the figure. A drawing of this kind will remove objections, nor can the intellect have assistance except through the figure. Let then a circle be described above the center of revolution, which is *o,* on the circumference of which the weights revolve, and let the horizontal diameter *ab* be drawn, and let another diameter intersecting this one be drawn directed toward the center of the earth, and let it be *dc,* and let equal arcs be marked on both semicircles on both sides of the horizontal diameter, and from both of its extremities, and from the ends of the arcs in both semicircles let lines be drawn parallel to themselves and to the horizontal diameter, namely *fh, gp, tq, sr,* all of which cut the diameter falling to the center of the earth. Of necessity then, according to Jordan and his commentator, those parallel lines will cut from the diameter directed toward the center of the earth unequal parts, so that the parallel which is nearest the horizontal diameter will cut a greater part of the other diameter than will a more distant parallel; as, *tq* will separate a larger part of the diameter *dc* than *sr,* so that the part of the diameter *dc* which is between *ab* and *tq* is greater than the part of the same diameter, which is between *tq* and *sr,* and in the same way the part of the diameter *dc,* which is between *ab* and *gp,* will be greater than that which is between *gp* and *fh.* Accordingly if a parallel is taken in the one semicircle, and another parallel in the other semicircle, which are equally distant from the diameter parallel to them, they will of necessity cut equal parts from the diameter falling to the center of the earth, as *tq* and *gp* will cut equal parts from *dc,* and likewise *sr* and *fh,* just as the twenty-sixth proposition of Jordan on triangles states. If, therefore, the parts of the diameter directed toward the center of the earth divided by the parallels are unequal, so that those parts of the diameter

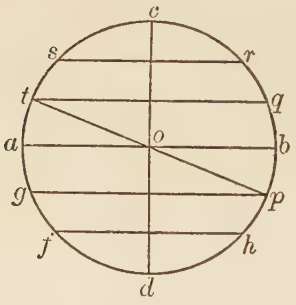


FIG. 20.

which are divided by the parallels nearer the horizontal diameter are greater; then first let us note that the beam of the balance lies on the horizontal diameter, and let the support be upright on the diameter falling through the center, so that the balance and its arms are in a horizontal position; after that let the balance be moved, and one part of the balance be raised to the first parallel on the upper semicircle, the other part depressed to the end of the first parallel on the lower semicircle, so that the beam is in the position of the line *tp* and part of the balance is higher at *t* than the other part at *p*. If, therefore, *p* should descend to the end of the other parallel *h*, it will cross on the diameter drawn to the center the part which is between the parallels *gp* and *fh*, which is less than that part of the diameter which is between *tq* and *ab*, as is clear from what has been said. Therefore if *t* should descend to *a*, it would take a more direct descent on the diameter drawn to the center of the earth than *p* while it is descending to *h*; wherefore *t* is heavier as regards position than *p*. And *t* again descends toward the center of the earth. But *p* on account of the bending of the circle is curved back from the center, and tends less toward the center, as is clear to the sense. It remains, then, that for this reason it will be less heavy. Since this is the case, the first objection is removed; for although the part of the beam *p* descending is nearer the center of the earth, as is clear if a straight line be drawn from it to the center *o*, because that line is shorter than the line which is drawn from *t*, as is clear to the sense, and thus is heavier in so far as it has a lower position, nevertheless since *p* does not move along that straight line *po* toward the center, but along the circular course of the circumference of the circle, and that circular course causes it to take a less direct course on the diameter drawn to the center than *t* takes, and bends and curves *p* from the center, so that it does not tend directly to the center like *t*, when it descends, of necessity *t* is heavier than *p* while they are in such a position. There-

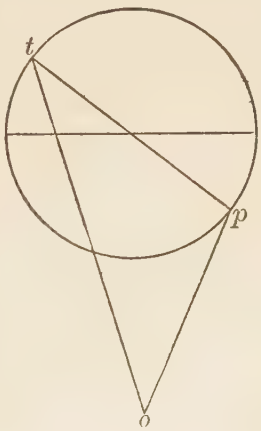


FIG. 21.

fore if they are left to themselves, t will descend, and p will follow its descent with an opposite motion, namely, an ascent to the position of equality. Therefore p will not always descend, but the two reasons for weight here given prevail over that of which the objection has made mention. Again that weight has no force, for it is slight and insensible, and therefore is not operative here, just as if a feather should be added to one of the equal weights, when they are in the horizontal position, it would not cause the weight to descend, and yet as a fact that arm to which the feather was added is the heavier, since the feather has some weight. Therefore the case is similar here; for the descending arm, when it is at its lowest point, is only a short distance from the position of equality, therefore the additional weight it acquires is only trifling and insensible, and therefore the acquired weight is not to be considered.

The other fact is then explained, which Jordan draws as a conclusion from the greater weight, that it will always descend with greater velocity, so that it will never rise. For it is now clear that this additional weight has no sensible effect, and the two causes of weight touched on above are found in the higher arm. When, however, he states in the third argument that it is less heavy because it follows the descent of the other with an opposite motion, namely, an ascent, I gladly grant it. For the lower weight is in this condition because it is ascending when the upper weight is descending, as is the case when they are left to themselves and are equal, as has been set forth. But not on this account does it ascend more and more, nor does the other descend without limit, but they merely reach a position of equality, and there they naturally come to rest, wherefore the objection draws a wider conclusion than it should when it wishes to conclude from this fact, because one ascends and the other descends, that they pass the position of equality.

And if it be said that at this point there is an oscillating motion and therefore the upper arm descends beyond the position of equality, and that the reason why it passes over a small distance and a large one is because this crossing over is of one nature, and similarly in regard to the other arm that it always ascends after it passes the position of equality; we must reply that this descent of the upper arm beyond the position of equality is not due to the nature of the weight itself, but to the

impacts of the particles of the air. For when the air is set in motion, it retains the motion readily, and therefore for a long time its particles vibrate hither and thither and do not permit the weight to come to rest at once in the position of equality.

The Application of Mathematics to Sacred Subjects.

After the necessity of mathematics has been proved in secular things, and in human sciences, the same can now be shown in divine things. And we must give this the more consideration, because human things have no value unless they be applied to divine things. Since then it has been shown that philosophy cannot be known unless mathematics be known, and since all are aware that theology cannot be known unless philosophy be known, the theologian must of necessity know mathematics. But God has placed created things in his Scripture, who alone knows the power of the creatures which he has made, nor can he have false perception, nor does it befit his own truth. Therefore since all things from the highest heavens even to the ends thereof are placed in Scripture by God and the angels, either in themselves or in their similitudes or in their opposites, and since the same knowledge applies to opposites, as Aristotle says, and truth is either in the universal or in the particular, the theologian of necessity must know the things of this world if he ought to know the sacred text.

Moreover, we see that the literal sense is based on a knowledge of the natures and properties of creatures, so that through suitable adaptations and similitudes the spiritual meanings may be elicited. For thus the sacred writers and all the sages of old expound, and this is the true and real exposition which the Holy Spirit has taught. Therefore it behooves the theologian to have an excellent knowledge of the creatures. But it has been shown that without mathematics they cannot be known. Therefore mathematics is absolutely necessary to sacred science.

This, in the third place, can be shown by its properties. Although what I maintain will be proved in many ways, yet I shall attempt to convince by means of the activities of the sacred writers together with a removal of the bad repute of mathematics which many ignorantly allege because they do not understand the testimony of the sacred writers. For the Patriarchs

and the Prophets before and after the flood discovered it and taught other men, first, the Chaldeans; then, the Egyptians; and from the Egyptians it descended to the Greeks; and it is not so clearly stated that they so labored in other sciences. But since through those men the divine law was given to us, and they were most holy men, and busied themselves only in the science which is most useful to the divine law, mathematics is for this reason in complete accord with the divine law. The lesser proposition has with it its own proof. The greater one is proved by triple authority. In the first place it is proved by the historians, especially by the chief of these, Josephus. For in the first book of the Antiquities in three places he mentions these sciences, and expressly tells all that our major proposition states. For he says that the sons of Adam discovered geometry, astronomy, arithmetic, and music; and Noah and his sons taught the Chaldeans; then Abraham taught the Egyptians.

In the second place, this is verified by the blessed Jerome and Cassiodorus and other sacred doctors, as even the rank and file of theologians knows; and the sacred writers ratify what Josephus asserts. In the third place, it is proved by the statement of philosophers. For Albumazar in the fifth book of the larger Introduction to Astronomy in the eleventh principle in the eleventh chapter states that Shem, the son of Noah, taught others this science, and in the prologue of the Astrolabe of Ptolemy it is stated that a zeal for this science is affirmed to have been inspired in the world by the son of Shem, who had been put in mind of it by the divine narration or perchance had been stirred by the divine command. The same is indicated by the activity of our sacred writers after the coming of the Lord, as Augustine, Cassiodorus, Isidore, Jerome, Orosius, Bede, Origen, Eusebius of Caesarea. For concerning these sciences have they written, and in them have they exercised themselves and others solely, or at least more than, in other sciences. Since therefore they were teachers of the sacred Scripture and were holy men, it is clear that sciences of this nature are especially valuable to professors of the sacred science. What, moreover, they have written concerning these sciences is shown by Cassiodorus and Isidore, who composed their treatises on all four of these subjects. Augustine also composed different books on numbers and music; Jerome treated of these subjects in different

books, and Orosius in writing to Augustine, and Eusebius in writing of the places in the world, definite knowledge of which is derived from astronomical sources, as is certain and as what follows will show. Bede wrote concerning the course of the sun and moon and concerning the whole question of the diversity of time, and both Origen and Eusebius wrote on subjects which are known to be based on astronomy. Not only did they write on these subjects, but they also taught these things to suitable men, in order that they might be sharp-witted against heretics, as is disclosed by Cassiodorus in mathematics and by the sixth book of the Ecclesiastical History; the divisions also of geometry and arithmetic are subjects of instruction, as is stated in the same book, which are more removed from sacred things than are astronomy and music. But not merely did they busy themselves in writing and in teaching others, but they also expounded theological truths through the potency of these sciences; as is shown without contradiction by all the original works of the sacred writers. This is evident in the matter of numbers and of places in the world and in celestial things and in others that are known to pertain to the sciences mentioned, as we shall show below.

But not only have they so expounded sacred things as a matter of fact, but they state that these sciences throughout the whole world have value for divine things, and they extol them beyond other sciences in this particular. Cassiodorus indeed speaks as follows in his preface concerning the arts and discipline of secular studies: "We can call mathematics in the Latin speech doctrinal, and although by this term we are able to designate all subjects of instruction as doctrinal, yet this science has properly claimed for itself the general word owing to its own excellence." And in his treatise on mathematics he thus speaks, "Those are subjects of instruction which never fail, deceived by opinions, and for this reason they are called by such a name. While we turn these over in frequent meditation, they sharpen our perception, they wipe away the filth of ignorance, and by the gift of the Lord they lead us to that speculative contemplation. Rightly do the holy fathers counsel us to read these sciences, since in great measure by them is our appetite drawn away from carnal things, and they cause us to desire those things, which, the Lord alone granting, we can view with affec-

tion. A twofold division of mathematics is assigned to numbers in common speech not only by the sacred writers, but also by the philosophers themselves, namely, arithmetic concerning numbers absolutely, and music concerning proportions and other relations which are found in numbers as referring to sound and gesticulation; because sound and gesticulation form a subject apart from music; but they are discussed however by means of the relationships of numbers in the science of music." Augustine, moreover, in the second book on the Order of Discipline says, "We should not aspire to any of the sacred writings without a knowledge of the potency of numbers." He also says in the same book on Christian Doctrine, "Ignorance of numbers causes many things placed in the Scriptures with a transferred and mystic meaning not to be understood"; and he furnishes many examples, adding that "thus under many other forms of numbers secrets are placed in the sacred books, which owing to ignorance of numbers are closed to readers." And therefore owing to the very great utility of numbers Isidore in his treatise on Arithmetic says, "Take from the world computation, and blind ignorance enfolds all things; and men cannot differ from other animals, which are ignorant of the method of calculating."

Moreover, although the praise of music is now manifest in common with arithmetic, because both take into consideration the relations that exist in numbers, yet numbers, as they exist in sounds, Augustine greatly praises, speaking to Memorius. "What importance numbers have in all motions of things is more easily considered in the case of what is uttered by the voice, and this consideration by certain graded roads presses on to the supernal paths of truth, in which wisdom joyfully discloses herself." And in the book of Retractions he says, "The sixth has become especially known, since in it a question worthy of being understood is treated, how from mutable numbers we arrive at the immutable, as if the invisible things of God are perceived through those things which have been made." Likewise in his book on Christian Doctrine he says, "Not a few things in the sacred books an ignorance of the principles of music closes and covers up"; and he gives examples in the case of the ten-stringed psaltery and the cithara and the like, and he adds that "we find music occupying an honorable posi-

tion in many places in the sacred Scriptures." Cassiodorus, moreover, judges that this science is of importance in the commands of God, in morals, in the sacred Scripture, and in all created things. Hence in his treatise on music he speaks as follows: "Musical training applies to all the acts of our life; first of all, if we are to do the bidding of the Creator and obey with pure minds the laws established by him, music is then the science of proper regulation. If we manage our life correctly we are always shown to have had our share of such training. When, however, we do injustice, we do not possess music. In religion itself there is also a strong admixture of music; whence the ten-stringed instrument of the decalogue, the tinkling of the cithara, the timbrels, the melody of the organ, the sound of the cymbals; without doubt the Psalter itself was named after an instrument of music, because in it is contained the exceedingly sweet and pleasing melody of the heavenly virtues; and to state the whole matter briefly, whatever in things celestial or terrestrial is done fittingly in accordance with the direction of its author is the result of this system. Most pleasing then and useful is the knowledge that lifts our mind to things above and charms our ears with its melody."

Concerning the utility and the knowledge of astronomical matters he says, "If we inquire after astronomy with a pure and disciplined mind it floods our senses, as the ancients say, with great brightness. For such is the result when we turn the mind to the heavens and investigate with inquiring method that whole celestial frame, and with mental acuteness by contemplation gather in part what mysteries of such magnitude have veiled." And he adds, "By these means, as it seems to me, to know the climes, to understand the lengths of the seasons, to note the course of the moon for the determination of Easter, in order that the artless may not be confused in regard to it,—all this does not appear silly. There is also another advantage from such studies which is not to be despised, if we learn from them the suitable time for sailing, the time for ploughing, the dog-star of summer, and the mistrusted storms of autumn." Augustine in the second book on Christian Doctrine, speaking of the utility of this science, maintains that its utility is threefold, namely, "a demonstration of the present, a knowledge of the past, and reasonable conjectures of the future. The demon-

stration of the present consists of the assignment of the properties of celestial things. Besides a demonstration of the present it possesses something like a narrative of the past, because from the present knowledge and motion of the stars we may revert regularly to their tracks in the past. It possesses also conjectures according to rule of the future, not full of mistrust and ominous, but definite and certain," as he says. Since the sacred writers feel thus concerning the three latter parts of mathematics, they must of necessity have laudatory sentiments in regard to the first part of the science, which to be sure is geometry. For on the knowledge of this the other parts depend, since it is the first of all and the root of the others. Cassiodorus, writing concerning the praise of this subject, speaks thus, "For if it is permitted to speak, sacred divinity since it has given to its own creation diverse species and rules, since by a power to be venerated it assigns the courses of the stars, and causes things that are moved to travel in determined lines, and places in a definite abode things that are fixed, whatsoever is well arranged and complete, sacred divinity, I say, can be attached to the qualities of this subject."

If we wish to consider the qualities of the study of theology, we shall find mathematics wholly necessary for seven important reasons. One is the knowledge of celestial things. For nothing is so fitting to theology and its professors. For theology is celestial by divine will; and therefore no human speculative science will befit it to the same extent as the science of the heavens. And by all Scripture we are called away from the things of this world and urged on to heavenly things. And our conversation according to the Apostle is in heaven if we are really Christians, and if we have the aspiration and the belief that we are to remain corporeally and perpetually in heaven. Wherefore nothing else should be so fully known by us as the heavens, nor should anything else be so desired. And if we rejoice to expound the Scripture, it is proper that the things which are placed in Scripture and cannot be known otherwise should be expounded by the properties of inferior things. Wherefore in like manner since there are in Scripture many difficult things concerning celestial matters, it is necessary for the theologian to know celestial things.

Moreover, since the vastness of things celestial stirs us to

reverence the Creator, and since there is no comparison in magnitude of things below with things celestial, the knowledge of things below will have no comparison with that of the things above as regards their end, which is the praise and reverence for the Creator. For Avicenna says in the ninth book of the Metaphysics that "those things that are under the circle of the moon are almost nothing in comparison with those things that are above it." And Ptolemy shows in the Almagest, and all astronomers know, that the whole earth together with all things below holds the same relation to the heavens as the center to the circumference. But the center has no quantity. Wherefore they draw a like conclusion in regard to the earth in comparison with the heavens, although the earth in itself may possess great quantity. The smallest of the visible stars, as Alfraganus states in the beginning of his book, is larger than the earth; but the smallest of the stars in comparison with the heavens has no quantity of any significance. Since from the eighth book of the Almagest and from Alfraganus it is evident that there are six magnitudes of fixed stars; any one of those belonging to the first magnitude is equal to the earth about one hundred and seven times; and any one of those belonging to the sixth magnitude is equal to the earth eighteen times; and the sun is about one hundred and seventy times larger than the earth, as Ptolemy proves in the fifth book of the Almagest. According to him it requires thirty-six thousand years for a star to complete the circuit of the heavens, owing to the vastness of the heavens, notwithstanding the fact that the star moves with incredible velocity. But the earth can be traversed at foot pace in three years. Wherefore the magnitude of things below bears no comparison to things celestial. The same is true of their utility; because the whole utility of things below is drawn from the things above. For the twofold position of the sun under the oblique circle together with the aspects of the planets is the cause of all that happens here below.

If, therefore, we consider things celestial as regards questions of theology, it is evident that theologians inquire in their collections of maxims and in their treatises on these collections whether the celestial orbs are continuous or discontinuous, concerning the number of the heavens, especially as concerns the ninth and tenth, concerning the shape of the heavens, concern-

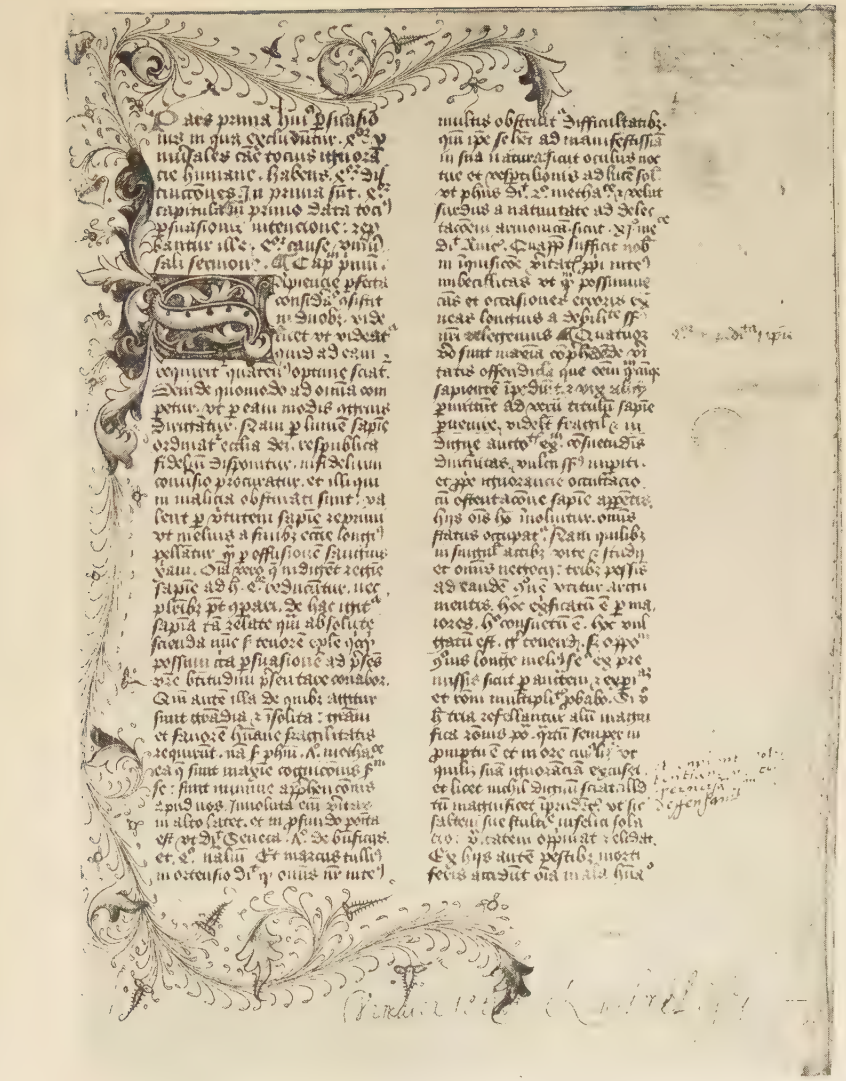
ing their circles, epicycles, and eccentrics, concerning their motions in these, concerning differences of position in the heavens, as right and left, before and behind, up and down, concerning the properties of the heavens, such as their light, transparency, and the like, concerning the influence of the heavens on things here below, and concerning the species of the heavens and of their nature elemental chiefly on account of fire. For Augustine and others sometimes following the opinion of Plato state that the heavens are of a fiery nature. They also inquire about the localities of the world because of paradise in their effort to determine whether it is under the equinoctial circle or not; and they try likewise to determine the location of hell. They inquire also whether celestial things have power over those things that are generated and corruptible and over the rational soul; concerning fate and like questions, decisions in regard to which are known to belong to astronomy. Other matters are arising daily without number in the inquiries of theology. But not only the treatises on the Sentences, but also the sacred text itself, together with the expositions of the sacred writers, require this aid. For the first chapter of Genesis has many difficulties because of celestial things, as is clear from the text itself and from the expositions of the sacred writers, especially Basil, Ambrose, and Bede in their books that are called Exemeron. In Joshua there is the difficulty owing to the length of the day when the sun stood still, especially in comparison with the length of the day, on which the sun went backward ten degrees at the word of Isaiah. For there seems to be a contradiction in these places. When Solomon says in Ecclesiastes that the sun every day, according to the exposition of Jerome on the original, turns to the north, scarcely any of the astrologers can understand this; since they know that from the winter solstice to the summer solstice the sun advances toward the north about one degree every day, but that during the other half of the year it travels in the opposite direction. There is difficulty also concerning the height of the firmament mentioned in Ecclesiasticus, and how the sun in the south consumes the earth, as is stated in the same book, men lack the astronomical knowledge to understand. The Hyades and Pleiades and Arcturus and Orion and the chambers of the south, of which the blessed Job speaks, possess great difficulty, especially when the blessed

Jerome says in commenting on Isaiah that Orion has twenty-two stars, of which the first nine are in the third magnitude, and nine others in the fourth magnitude, and the four remaining ones in the fifth magnitude, and makes no further statement. But these things cannot be known except from the eighth book of the Almagest, where six gradations of magnitude of stars are given, and the stars that belong in each magnitude are determined. There are also other matters almost countless in number in Scripture and in the expositions of the sacred writers which touch upon the science of the heavens and the decisions of astronomy: wherefore the theologian of necessity must be well informed about things celestial, both on account of the anticipation of questions in collections of maxims and in summaries, and on account of the sacred text itself.

The second head of astronomy, as regards theology and especially as regards the sacred text, is the study of the places in the world. For the whole text is full of these places, and for this reason nothing of importance can be known unless these places are known. For the whole series of Scripture deals with regions, states, deserts, mountains, seas, and other places of the world, certitude with respect to which cannot be gained except through the sciences mentioned, because it is the function of these sciences to distinguish the habitable parts from the non-habitable, and to divide the habitable into three great divisions, Europe, Africa, and Asia, and these three into seven known climates, with many other irregular climates besides. These climates no one can separate with certainty except by virtue of these sciences into provinces and districts and other localities, so that well-known and famous cities may be found, such as Jerusalem, Babylon, Meroë, Alexandria, Antioch, Ephesus, Athens, Tarsus, Rome, and the rest, determined in comparison with others according to the required distance between them, both east and west, north and south. These having been found, it will be possible to find famous regions named from them, also seas and deserts and mountains and all things that are contained in sacred writings. For here these sciences possess great usefulness in sacred Scripture. And perhaps nothing connected with philosophy will be found more useful; since for the man ignorant of the localities of the world the rind of history frequently has no taste because of the infinite number of places, and espe-

cially owing to the manifold falsity of the new Bibles; and as a consequence he will be impeded in rising to the spiritual meanings and only imperfectly will be able to explain them. But he who has gained a good idea of places, and has learned their location, distance, height, length, width, and depth, and has tested their diversity in heat and dryness, cold and humidity, color, savor, odor and beauty, ugliness, pleasantness, fertility, sterility, and other conditions, will be pleased very greatly by the literal history, and will be able easily and admirably to gain an understanding of the spiritual meanings. For there is no doubt that corporeal roads signify spiritual roads, and corporeal places signify the ends of spiritual roads and the similitude to spiritual places, since place has the quality of terminating local motion and furnishes the reason for stopping, and therefore the knowledge of those places both causes the literal meaning, as we have said, to be understood, and prepares the way for understanding the spiritual meanings: a fact which is established fully by the words and deeds and writings of the sacred authors.

In the first place, because Jerome says in the prologue to the second book of Chronicles, "He will have a clearer insight into the sacred Scriptures, who has viewed Judea with his own eyes, and has learned the memorials of the ancient cities and the names either the same or changed of the places." In the second place, because the sacred writers have labored in viewing those places and in traveling over them. Wherefore the blessed Jerome says in the prologue just mentioned, "We made it our care to undertake this labor along with the most learned of the Jews, that we might traverse the province of which all the Churches of Christ speak." Moreover, he would not have done this except for the purpose of understanding the sacred writings. In the third place, because he has written many books about places in the world, determining their distance, location, and other facts in regard to them with great certainty. Orosius also gives Augustine a very useful, truthful, and clear account of these places. Isidore, moreover, in many places locates districts and states in a more useful way, if we may say so, than the former writers. Cassiodorus, moreover, does not omit to distinguish them in respect to their climates. Eusebius of Caesarea also, as Jerome states in his book on places, after the geography



A PAGE OF THE OPUS MAJUS

From the Digby Manuscript in the Bodleian Library

of the land of Judea and the assignments of the tribes, and a picture of Jerusalem itself and of the temple in it with a very brief exposition, labored at the end to collect for us from sacred Scripture the names of nearly all the cities, mountains, rivers, hamlets, and different places, which remain the same or have been changed or corrupted in part. Origen the Adamantine in his commentary on Joshua in the original, in agreement also with the gloss on the eighteenth chapter of Joshua, speaking of the multitude of places mentioned in Scripture and amid other praises of those places, addresses us thus, "Do not read these names with disdain nor think Scripture a worthless texture of many names; but be assured that in these are contained greater mysteries than human speech can utter, or mortal ear hear!" Since then the sacred expounders and doctors have labored so much on those places, and confess that such great mysteries are contained in them, there is no doubt that a knowledge of them is necessary in every way for the sacred Scriptures. But it is the function of astrology and astronomy to give explanations and full certitude in regard to the places in the world. Wherefore these sciences are very necessary in this particular. These statements can be fully verified in examples. For he who hears the accounts of events that took place about Jordan, Jericho with its plain, Mount Olivet, the Valley of Jehoshaphat, and Jerusalem, and has no conception of those places and of their nature, will be ignorant of the literal sense, and will, not undeservedly, have little appreciation of the course of history, and in consequence is blind to the spiritual meanings. But he who knows the lengths, breadths, depths, heights, variety of qualities, as heat, cold, dryness, humidity, and of those following these four, softness, hardness, thickness, thinness, harshness, smoothness, aridity, fluidity, slipperiness, and innumerable other qualities, which are defined in the fourth book of the Meteorologics; moreover, colors, savors, odors, beauties, ugliness, pleasantness, sterility, fertility, matter infected, corruptible, and their opposites, and others which have to be considered in their place,—he who knows all these can understand clearly the literal sense and delight himself in it, and can pass to the spiritual meanings in a calm and glorious manner.

For by considering a few facts relating to the places named,

we can express important meanings in a moral, allegorical, and analogical sense. The Jordan flows from the north to the south, and lies to the east of Jerusalem, which is in the west not far from the great sea, and between those two first from Jordan is the city of Jericho with its plain, then Mount Olivet, third the Valley of Jehoshaphat, and then Jerusalem. The world, sacred writers say, is symbolized by the Jordan according to the explanation of its interpretation and because of its properties, since it empties into the Dead Sea, which is a figure of Hades, and the Jordan is so considered for many other reasons. Jericho signifies the flesh, as the sacred writers maintain. Mount Olivet signifies the excellence of the spiritual life, owing to the excellence of the mountain and the sweetness of devotion owing to the explanation of Olivet. The Valley of Jehoshaphat signifies humility owing to the explanation of valley, and true humility before the eyes of majesty, because the interpretation of this name Jehoshaphat is, in sight of the Lord. Jerusalem signifies the vision of peace, and morally it is the sacred soul that possesses peace of heart; allegorically it signifies the Church militant; analogically the Church triumphant.

He therefore who from the beginning of his life or the hour of his nativity in the morning of deliberative reason or with the possession of this faculty desires to arrive at least in the evening of his life and in old age at peace of heart, and this I mean in a moral sense; and he who wishes to be a faithful and perfect member of the Church, under whose shadow he may lie in peace from the insults of the malignant foe, and this I mean in an allegorical sense; and he who wishes that his conversation may be in the heavenly Jerusalem in this life, and that he may pass at death to that holy city, where he shall sit in the beauty of peace in the tabernacles of fidelity or in opulent rest—such a man should first either leave behind Jordan, that is, the world, by subjecting it to him, as the sacred writers have done who remained in the world, or withdraw from Jordan by wholly renouncing the world, as members of religious orders do. For at this point is the first step in the spiritual life and an easier one than the others. When this has been done, he must attack the flesh, because it is not so easy to conquer this as the world. For it is a familiar plague and does not leave its subject. But he must not destroy the flesh and crush it with

force, but gradually and discreetly must he conquer its pride. For this reason the flesh is considered Jericho with its plain; and therefore he must proceed as a penitent along the level road, in order that the obedience of the flesh may be a reasonable one, lest if he foolishly overwhelm the flesh he may not be able to reach the higher things of the spirit. For this statement is directed against many who, having been turned to penitence, destroy their bodies in the first or second year, and afterwards become useless, so that they are able to aid neither themselves nor others. After a man has brought the world under subjection, and has conquered the flesh as he should, then and not before is he fit to ascend to the excellency of the spiritual life and to the sweetness of devotion. For then is he able to ascend to Mount Olivet and to reach the summit of perfection and to plunge into the sweetness of prayer and contemplation. When he has been sufficiently exercised in the ascent and passage of that height, he must then cross the Valley of Jehoshaphat, that is, he must conclude his life in perfect humility, that he may be poor and humble in spirit in the sight of God, not in his own eyes or in those of men. For many appear humble to themselves and to others and are before God and the angels most proud. When he has completed his whole life in perfect humility, then is he in Jerusalem, according to its triple sense. For he will have peace of heart, because such peace follows the perfection of the spiritual life. "For there is no peace for the wicked," says the Lord. But to the holy belongs the peace of God, which passeth all understanding, and in the peace of the Church militant such a man rests secure, a peace which unbelievers and sinners living in a state of damnation lack, whom the devil confounds and drives from sin to sin, and from the punishment of sin to fresh punishment. And as has been said, the sanctified man will participate even in this life in certain hope and in revelations by means of that blessed vision of the peace of Jerusalem above, which he shall obtain by the grace of God at death.

But not only these places between Jordan and Jerusalem make history clear and explain spiritual meanings, but other places also without number that are found in Scripture between these two limits. If any one should wish also to consider further the other qualities enumerated, much more and

almost incomparably will he be able to bring out the divine meanings, as is evident to him who examines the matter. But it suffices merely to hint how we can succeed in drawing forth many things from few, great things from small, obscure things from those that are more manifest. But the places of the world cannot be known except through astronomy; since it is necessary for us first to know the longitudes and latitudes of such places. Latitude is measured from the equator and longitude from the east, that we may know under what stars places belong and how far they are from the path of the sun. For in accordance with these we see sensibly that the affairs of this world vary, not only in the things of nature but also in things pertaining to morals. It is necessary also to know through astronomy what planets hold sway over the different regions; for in accordance with this principle are regions greatly altered. Many things of this kind must be considered by means of astronomy, that we may know the natures of the places in Scripture; and this information is necessary not only on account of the places, but also because of the things located in these places. A knowledge of all things is necessary for the spiritual as well as the literal sense, as is clear from what has been said.

The third head relates to chronology. For the whole course of history is traced through times and generations and ages from the beginning of the world to Christ the Lord, and all things have been set in order on his account, that no other legislator might be expected, but that he alone may be the Savior of the world by his own law; that the error of the Jews regarding their expectation of the Messiah may be removed; likewise the error of the Saracens regarding Mahomet, who followed Christ; also the error of those who shall still adhere to the proposer of the law of wickedness, who is to come, as Albumazar teaches in the book of Conjunctions, and who in reality will be Antichrist; in order that all sects of pagans, idolaters, Tartars, heretics, and other unbelievers, who throughout the world have been scattered into sects almost without number, may be destroyed through a certification of the time of the Savior, that neither before nor after him may any other be considered, through whom the salvation of the human race may be accomplished. But no one can certify in regard to times

except the astronomer, nor can any other science than astronomy certify in regard to them. For all beg for its leavings in this respect, as is clear. And if we consider the matter, we shall find in many ways how necessary astronomy is in this particular. For some of these calendars are lunar, some solar and lunar, some have a fixed beginning, as with the Jewish astronomers. For they begin the year with the moon in October, because they have used from antiquity tables and canons for the setting of the sun at the city of Jerusalem. But they still are glad to use these on account of the land which was given them by God. Some calendars have an undefined beginning, as the times of the festivals among the Jews, and the calendars of the Arabs, and in this they differ much. Certain calendars are solar, and of these certain have always had a fourth besides the full days, like the calendar of the Greeks and Latins; certain have never had this, like the calendars of the Persians; certain have it at one time and not at another, as the calendars of the Egyptians. And the beginning of the year varies among them, as the canons of astronomy teach as well as the Almagest, and there are many other variations. Since, therefore, there are contained in Scripture years lunar and solar as well as those of the Greeks and Latins and the like, and we wish to reduce all the calendars to solar years and to the years of the Latins, which are the years of Christ, it is necessary for us in sacred history to know the differences of these calendars, and also to know what is peculiar to each and how they may be equalized, and how we can draw the greater from the less and the converse, and extract any information desired from any one of them. But this cannot be done, as Scripture requires, except by means of canons, tables, and other astronomical means. But years are computed from the beginning of the world, according to the original Hebrew and according to the translation of the Seventy; but they disagree internally, and all authors of history and chronicles and sacred writers in this matter contradict one another in turn, not only in the matter of the whole time from the beginning to Christ, but also in regard to the particular ages. But this diversity cannot be cleared away except through a sure source. No science can in this matter discover nor has it the ability to ponder on the means of settling such an important question except astronomy, whose function it is to consider the

definite and determined revolutions of eclipses, conjunctions of planets, and other celestial revolutions, the order of nature remaining fixed. Wherefore it is necessary that astronomy should here bestow diligence. For Ptolemy in the Almagest certifies us in regard to the time from Nabugodonosor to Alexander and from him to Octavianus Augustus, and from him to Prince Adiran. The Church holds that in the forty-first year of Augustus the Lord was born. Wherefore by this means there is certified much time from Nabugodonosor to Christ. If we consider the views of Albumazar in his book of Conjunctions, we shall see that he fixes the beginning of the world and the first man, namely, Adam, and from him numbers the years to the flood, and fixes the day and hour in which the flood began, and by the revolutions of the planets and by their conjunctions determines the following ages, and the dates of Nabugodonosor, Alexander, the Lord Christ, Mahomet, and of many others. Therefore by the skill of Albumazar and Ptolemy and other astronomers it behooves us to account for the times back to the beginning of the world, so that we know how many years there are from the beginning to Christ, not only as a total, but as regards the separate ages and periods.

In the second place, we can argue for the utility of astronomy because of the determination of the beginning of time, whether it is to be reckoned from the October lunation, the autumnal equinox, or the vernal equinox. For many have maintained according to the general opinion that the world was created about the time of the vernal equinox; but others have held that it was near the autumnal equinox; because according to the Hebrew text, the year, as far as it concerns the natural sequence of time, begins about the autumnal equinox. This fact can be clearly proved by the text of Exodus, where it is said that the Feast of Tabernacles is celebrated at the end of the year, that is in the month after the close of the year. For the twenty-third chapter reads thus, "The feast also in the end of the year when thou hast gathered in all the crops from the field." Therefore the feast begins after the first of the new year. The thirty-fourth chapter of the same book says, "Thou shalt make a feast when at the return of the time of the year all things are stored away." And in the gloss of Jerome on the first chapter of Ezechiel it is stated that October is the first

month of the year and January is the fourth. And in the first chapter of Nehemiah, "and it came to pass in the month Caslen, that is December, in the twentieth year"; and in the second chapter, "It came to pass in the month of Nisan in the twentieth year." For if Nisan, that is, April, were the beginning of the year, it would not be stated in the twentieth year, but in the twenty-first year, as is apparent. In like manner we may reason from the commands in regard to sowing and reaping the fields, owing to the rest of the seventh year. For if Nisan, that is April, were the beginning of the year, then the sowing that is made in September or October of the sixth year will not be able to be harvested in the seventh year, since it is holiday according to law, and so the crop will perish. Likewise, since the whole seventh year is holiday, if the year began from April to September, they would not have anything to eat, because the crops of the sixth year will suffice only for the seventh year and for the eighth and for the seed of the eighth, as Josephus states, and not for the ninth year. Likewise by Jerome in his letter concerning Feasts that same matter is made clear. For he speaks thus, "At the end of the solar year among the Jews in the seventh month, when the fruits are gathered into barns and storehouses, then were they directed to keep the feast by law, on the first day of trumpets, on the tenth day of atonement must the sabbath be kept. And from the fifteenth day until the octave of the tabernacles be finished, they are enjoined to keep holiday."

But it is now made clear by Bede in his book on Chronologies, and especially by Josephus and all the Hebrews from the beginning on, so far as concerns the commencement of the festivals, that Moses began the year with April on account of the Passover, which is the first festival, and on account of the mystery of the new chronology, namely, the Christian, the years of which are computed from the incarnation, which was about the equinox, and at which time glorious Easter is now observed. But in selling and buying and in the rest of his government, so far as concerns the beginning of the year, Moses kept the decrees of the prior age, as Josephus states in the first book of the Antiquities. Now the prior age extended from Moses back to the beginning of the world. Therefore since the beginning of the first year of the world and the beginning of the world were

the same, those men conclude that the world began about the time of the autumnal equinox, so that after the spoliation of the fruits of the old year the cultivation of the new might begin. Now this dispute is a very serious one, and for this reason wise men have recourse to the science whose function is to give definite information in regard to chronology, I mean the science of astronomy. Those also who hold the first opinion wish to protect themselves by astronomy, saying that the world was created under a better arrangement owing to the generating of man and of things, and for this reason the planets must have been in their more favorable position with respect to their control of the world. Wherefore they maintain that the sun was created in the middle of the world, as it is on the equator, so that it occupied an equal position with respect to the whole world. And they placed the sun in Aries, not in Libra, because the astronomers say that there the sun has its exaltation, which is its major dignity or second after the major. For the sun has five dignities and forces, namely, exaltation, house, triplication, terminus, face. And again they maintain that since planets must have eccentric orbits, it was necessary for the world, that the aux* of the sun should have been in Aries, because the position of aux is far nobler than any other part of the eccentric orbit. For when the sun and moon and other planets are in the position of their aux, they possess a stronger and better control in this world, as astronomers decide and as experience teaches. From all these considerations it follows, according to these men, that the world began at the vernal equinox. As to the objection made to them, that all growing things of the earth were created in the maturity of their fruits, which does not occur in the course of nature, they say that this was accomplished by the power of the Creator and not by the action of nature, although they add that in many southern regions is the heat of spring more favorable for maturing fruits than that of summer. And not only in spring, but again in autumn do they bear fruits, because of the temperateness of both equinoxes. Others, however, who take more things into consideration, namely, the reasons given above concerning the beginning of the world, reasons convincing and incontestable according to the view of those who hold the opinion quoted above, try to prove false the opin-

* Position farthest from center of motion.

ions of their opponents by means of astronomy. For they assert that the ancient astronomers fix the commencement of the year about the beginning of October, as is clear in the explanation of the tables that are called Almanac. And they say that Ptolemy discovered with certainty the aux of the sun in Gemini in his time. But if at the beginning it had been in Aries, as at the exaltation of the sun, namely, in the fifteenth degree or in the nineteenth, in which the exaltation of the sun is placed, the aux would move according to the motion of the planets, namely, according to the signs opposite to the motion of the first heaven. But this cannot be, because in that case the habitable regions above which the aux is would become uninhabitable in the succession of time, when the point opposite to the aux arrived above them: for which reason they maintain that the aux moves according to the motion of the starry heaven, not according to any imagined motion whatever, but by the motion of the Indians and of Thebit, namely, by the descent and ascent of its poles, or by the motion of the heads of Aries and Libra of the starry heaven in a small circle around the fixed heads of Aries and Libra, which are in the ninth heaven. By this motion the heads of Cancer and Capricorn are moved, advancing and receding on the surface of the ecliptic of the immovable Zodiac now to the east, now to the west, as is apparent according to the idea of Thebit, who to the works of Ptolemy adds in this particular the opinions of the Indians. For thus motion is assigned to the eighth sphere. In this view Arzachel agrees in his tables and canons, also Albumazar in his book of Conjunctions, and all astronomers now hold this opinion. But they thus maintain that the aux of the sun moves forward and backward and so does not depart from the sign of Gemini, for which reason it does not move in a circuit about the earth, so that the point opposite to the aux should at some time touch the habitable lands.

But those who maintain in the way mentioned that the sun was created in Aries, say that paradise is under the equinoctial, owing to its maximum temperateness, because both are the noblest places of the world, as they maintain. But if the aux were there at the beginning of the world, then was the point opposite to the aux in the position of Libra, wherefore at the autumnal equinox of the same year the sun was above the same

places. Therefore at that time was the temperateness removed, and the excellence of the climate of paradise and of the whole equinoctial region was destroyed yearly, which is contrary to the nature of those places in view of their position. For they were thus quickly rendered uninhabitable because of the point opposite to the aux, because at that time the sun is near the earth and burns it. But they themselves maintain that the more temperate part of the world is beneath the equinoctial, and particularly in the case of paradise, which cannot be made to agree with what has been stated. And therefore those who thus object maintain that the sun was in Libra, so that punishment might follow immediately on the sin of Adam, in order that, having been driven from paradise, he might not be able to attain to it because of the consuming heat of the region beyond the equinoctial. And for the production of this combustion, immediately after the ejection of Adam from paradise, continuously this side of the equinoctial, it was necessary that the sun should be in Libra, because there it would have been placed toward the point opposed to the aux beyond the middle of the eccentric circle, so that combustion will begin at once, which would not have happened in Aries. Many astronomical considerations are here present. For this reason the theologian in this particular should be well acquainted with the principles of astronomy.

In the third place, the theologian needs the viewpoints of astronomy now touched upon because of the longevity of Adam and his sons even after the days of Noah, of whom Scripture speaks. For it is strange how the age of man has declined, when in the beginning it was of such great length and spanned so much time. Therefore many impute it to the excellence of the celestial constellation at the beginning of the world, and about this period. They investigate this excellence by means of the dignities of the planets, maintaining, as I have said, that the sun was at the equinox and in Aries and at aux, and that the other planets were in good positions and in favorable aspects, so that human nature might be fortified by the excellence of the constellation at the beginning, to the end that it might be able to live so long. But gradually, owing to the failure of the aforesaid excellence because of the changes of the position of the planets and the stars, the life of man was shortened,

so that it arrived at a limit beyond which it does not succeed in passing; because of all things consistent with nature there is a reasonable explanation and an end, as Aristotle maintains, which limit Scripture fixes around eighty years in vigor, but beyond this is labor and pain. But we have already touched upon the way in which other astronomers object to these arguments. The dispute in regard to this matter is an important one; and perchance it will be discovered that the decline in the age of man is not due to a receding from the favorable disposition of the world at the beginning, but for other prescribed reasons, as we shall set forth below in its proper place.

And in the fourth place, it is necessary that the beginning of the year should be settled because of the deluge. For, as Josephus says, the deluge was in November. For these are his words, "Moreover this event happened in the six hundredth year of Noah's life, in the second month, which is called Dios by the Macedonians, but Maresvan by the Hebrews." But Dios, as Bede says in his book on Chronologies, is November, not May, as the rank and file of theologians consider it, and therefore Maresvan is November, just as Bede likewise states. And it is the second month, because October is the first in the natural order of time, as has already been proved. Hence, Bede says, For Tisseri, which is October, precedes Maresvan, because of the gathering of the crops and because of very celebrated feasts, and the Hebrews call this Tisseri the new year. For thus in Egypt they arranged the year so that Tisseri, that is, October, should begin it. And for this reason the Master of Histories and certain commentators did not understand Josephus when they believed that Dios and Maresvan were May. For this reason all those following them have been deceived because of the Greek and Hebrew names of the months of the Greeks and Hebrews, which they did not understand, as is clear to one examining the view of those who prove that the beginning of the year and of the world was about the time of the autumnal equinox of the year. For this reason the same perplexity occurs here as before. Hence the deluge must have happened in November, in accordance with the proof given above that time naturally began with October. Josephus shows this clearly to every man acquainted with the Greek and Hebrew names of the months of the year.

Not only concerning the beginning of the world and the year is there doubt among the theologians, but also concerning the beginning of the natural day, whether in fact night preceded the artificial day or the converse. This matter must be introduced here as the fifth point in regard to the substance of time. Many say that the day preceded the night, and expound Scripture, as they are able. But according to Jerome's comment on John and on Matthew, night preceded day. For, as Alfraganus says in his Astronomy, "All nations that use lunar months begin the day at sunset." But the Hebrews and the Scripture use lunar months and years, as can be proved in many ways. Therefore the Hebrews and Scripture use the natural day, the night of which precedes the day. Therefore the astronomical tables of the Hebrews, which they used in settling questions of chronology, were arranged with reference to sunset at the city of Jerusalem, just as the tables of the Latin astronomers have been arranged with reference to noon at the city of Toledo or of another city. Wherefore it is settled in the law that the day begins at evening. For in the twenty-third chapter of Leviticus it is said, "From evening to evening shall ye celebrate your sabbath."

The fourth head of mathematics in its relation to theology deals with the accidents and occurrences belonging to chronology, of which kind are the first and other phases of the moon, intercalations, and the like. For the text and the expositions of the doctors require a vast knowledge of these matters, and especially so respecting questions in regard to the Hebrews, pertaining to astronomy as well as to usual topics. But this division of the subject differs from the one treated above, because the former deals with the substance of chronology, but the latter with its properties and accidents. Therefore the basic truths regarding occurrences of this kind must be considered, before our discourse takes into consideration the Scriptures, because otherwise our argument would be unintelligible. I say, therefore, that the beginning of lunation according to astronomers is not reckoned from the moment when the new moon is visible among the Hebrews, as some theologians have said, since this time is not equal, as Alfraganus shows. But one lunation is made equal to another. For sometimes the horns of the old moon in its wane are seen in the morning and on the same

day in the evening the horns of the new moon are visible, and sometimes these phenomena are separated by a space of three days, as observation shows and Alfraganus states. Therefore the Hebrews in ancient times determined by means of astronomy the beginning of lunation, and since this did not occur at the moment when the new moon became visible, nor could it be known by sight, they lit torches on a high mountain at Jerusalem, that it might be known that at that moment the lunation began, so that men might be ready to perform the solemn acts and keep the festivals which they had to observe. The lunation is not reckoned with respect to the true conjunction of the sun and moon, since this time is not equal, as the astronomers know. But the moon must be reckoned with respect to the mean conjunction of the sun and moon, as Alfraganus says. For this period of time is always equal. It is not, however, said to be the first of the moon at the conjunction, but after the conjunction, when the moon is so far separated from the sun that it is as regards itself visible, although it cannot be seen. For then occurs the first illumination of the moon, although the moon is not seen at that hour. This diversity happens owing to the latitude of the moon differing from the Zodiac, and in accordance with the fact that it is in the signs of an oblique or straight descent, and according to the difference in the regions in the north and in the south, as Alfraganus teaches in the twenty-fifth chapter of his book. Now the period of the moon runs from the first to the twenty-ninth and a little more. From these periods is reckoned the time of mean or equal lunation, which the astronomers of the Hebrews and of the Arabs call a lunar month, although it may be called a lunar month in many other ways. Although the most skillful astronomers in their tables and canons maintain that the time of equal lunation is twenty-nine days and thirty-one minutes of a day and fifty seconds, as Arzachelem shows in his Toledo tables; yet the Jewish astronomers have given the subject more delicate and accurate consideration. For the time mentioned contains twenty-nine days and twelve hours and forty-four minutes of one hour, as the algoristic work will explain. But the Hebrews divide one hour into 1080 parts, and every minute of the hour contains eighteen parts of an hour, as is clear from the reduction of fractions of one kind to fractions of another. Therefore the

time of equal lunation among the Hebrews, corresponding exactly to the lunation of the Arabs, cannot be more than twenty-nine days and twelve hours and 792 parts of an hour. But the Arabs in their tables and canons make too small a computation, and reckon each lunation less than it should be by three seconds and fifteen thirds and forty-four fourths, as is evident on exact examination. For this reason the Hebrew astronomers, wishing to complete the lunation, have added one part, because they could not add less according to this scale which they use. Therefore they reckon even up to the present day in one lunation twenty-nine days and twelve hours and 793 parts of an hour. Their reckoning is far surer than that of the astronomers using the tables and canons current among other nations, although their computation is slightly in excess of the exact length of a lunation. For they exceed it by four thirds and sixteen fourths of an hour. But this is far less than the error of the Arabs mentioned above. Wherefore the computation of the Hebrews is considerably better. We need not take into consideration the excess mentioned above in the Hebrew computation; since in a very long period of time the error amounts to very little and is negligible. The months, moreover, of the Hebrews and those occurring in Scripture are not uniform. For one is of thirty days and another of twenty-nine, because people in general cannot compute except in entire days.

Having considered these matters, therefore, because they enable us to understand the Scriptures and the sacred writers, we are met with the further consideration that we should know that the Jews use a lunar cycle, a consideration of which is necessary in expounding Scripture. For just as we use a cycle of nineteen years, so do they use a lunar cycle, the first year of which begins in our fourth year. Therefore those men speak falsely who have not maintained that the Jews use a cycle; for they have intercalations in their cycle, just as we have in ours; nay, we have taken ours from them; and by means of intercalations they make the lunar years equal to the solar years by collecting eleven days thrice, in order that they may make in the third year an intercalated month, that is, one in excess. And we have taken this method of intercalations from them. Therefore famous men make a wrong statement who say that the Jews did not use a cycle. The Jews collect thirteen

lunar cycles and make a table and canon in accordance with it. These thirteen cycles contain 247 years, because in so long a period of time all the observances of their legal festivals recur at the same moment of time. Therefore legal observance in many ways proceeds in accordance with this, and many other matters besides. For new moons and firsts of the month, on which falls the observance of sacrifices and of solemn feasts, of which it is said in the first book, twentieth chapter, of Kings, "Tomorrow will be the first of the month, and thy seat will be required," make it necessary that we should know that the lunar month in general begins at sunset. But the lunation itself has no fixed beginning. Wherefore if the new moon should happen at sunset or before it at some hour of the preceding natural day, the new moon will be reckoned as occurring on the evening following, likewise the first of the month and the new month, because it is already new moon. If, however, it occurs after sunset, as, for example, at the second hour of the day or later, neither new moon nor first of the month, so far as its commencement is concerned, will be reckoned on that natural day. We must consider, however, that the first month lasts from sunset of the first day until sunset of the thirtieth day, and yet the lunation does not last except from the beginning of the night to the morning of the thirtieth day, counting in whole days, although some fractions remain over. The second month, therefore, does not begin before sunset of the thirtieth day, but its lunation begins in the morning of the thirtieth day, and therefore the two first days are assigned to the second month, on which occurred the feasts and sacrifices, namely, on the artificial day of the thirtieth day of the first month and on the thirty-first natural day, because those two days are from the lunation of the second month, although the second of these alone is part of the second month. Wherefore in the first book, twentieth chapter, of Kings it is said that the seat of David on the second day after the first of the month appeared vacant. Whence it happens that even months have always two days of feasts, but odd months have only one. From these facts the statement of Ecclesiasticus becomes clear, "From the moon is the sign of the feast day; the month is called after her name." From these facts it could be determined whether it was new moon at the beginning of the world or full moon, as

many have stated. For the Jews and Scripture use lunar months. Therefore the beginning of the first month and the beginning of the world were identical. But the lunar month begins with the new moon. Wherefore at the beginning of the world there was new moon.

What has now been said is necessary in considering Noah's exit from the ark. For the glosses involve us in grave doubt, wherefore the Master of the Histories was deceived, when he maintained that Noah's exit occurred on the twenty-eighth moon on the same day as regards the month on which he entered. For if this were true, then he was in the ark not only for a year, but for a year and a day, because a solar year consists of 365, which are completed from the first day of January to the last day of December, which is the end of the year. This is Bede's statement in his work on Chronology, "Noah with his family entered the ark on the seventeenth day of the second month and on the twenty-seventh day of the same month after the deluge is stated to have gone forth from the Ark. It is clear, therefore, that a whole solar year, that is, 365 days, was described, because doubtless the moon, which in the present year, let us say, appears on the Nones of May as the seventeenth, will occur the year following on the day before the Nones as the twenty-seventh." Such is Bede's statement. Because whatever moon it is, if you add eleven you will have the total on the same day, a year later. For example, if today is the first, the same day a year later will be the twelfth. Now this is true as a rule. However, sometimes its revolution is only the eleventh, sometimes the thirteenth. Concerning the eleventh, for example, if the first takes place today, the day before the Nones of April, on the same day a year hence it will be the eleventh. Concerning the thirteenth, let us suppose that the first occurs today, the fifth before the Nones of May, on the same day a year hence it will be the thirteenth. Let any one count it up and he will find it so for himself. This whole perplexity of the Master arises from a gloss of Strabus. In order, therefore, that we may reconcile the gloss of Strabus with Bede, we say that Strabus' statement in regard to the same day ought to be understood as the same day of the week; for example, if Noah entered on Sunday, he came out on Sunday. It follows that if eleven be added to the day present in his thought, that day being counted

with the eleven, he is correct in his statement, and this is proved by what he appends, therefore after a year the eleven being added, it was the twenty-seventh day, or twenty-seventh moon. For if the twenty-seventh day itself were excluded, it would be proved to have been not the twenty-seventh, as he himself maintains in his gloss, but the twenty-eighth. And this is made clear as follows. For since he entered the ark on the seventeenth moon of the second month, it is evident that the year following by the sixteenth moon of the second month the lunar year of 354 days was completed: moreover, from the seventeenth to the twenty-seventh are eleven days, and if these are added to the aforesaid 354, it will become a solar year of 365 days, just as Bede computed above. Thus, therefore, he came out on the same day of the week on which he had entered, but not on the same day of the month. And thus both spoke the truth. But the Master, however, did not give the correct explanation of the statement of Strabus. That, in fact, the seventeenth moon should be included within the eleven is made clear by another gloss, which by the addition of ten exclusive of the seventeenth counts up twenty-seven. Therefore if Strabus reckons up with the addition of eleven only twenty-seven, and the other man by the addition of ten likewise reckons up twenty-seven, it is evident that the former understood it inclusively, the latter exclusively. When, however, the Master wishes to excuse himself on this point and gives the reason why he said that the exit was on the twenty-eighth, whereas Bede says it was on the twenty-seventh, the former's statement being, "for it was possible that he came out of the ark in the evening of the twenty-seventh moon, with the twenty-eighth close at hand, but intermediate times are frequently expressed by any designation you please of their limits";—an explanation that amounts to nothing, because although a true or mean conjunction of the sun and moon may take place every hour of the day as well as of the night, yet the Jews and Arabs compute according to lunar months, and the moon belongs to the night, just as the sun belongs to the day, therefore days and months all begin in the evening. Bede makes these statements concerning chronology, "At whatever hour the moon is illuminated, before evening comes, it will not be called the first." If, however, it is illumi-

nated after sunset, it will be reckoned not the first on the preceding evening, but the thirtieth.

The Master's statement in his comment on Exodus regarding the arrival of the sons of Israel in the wilderness of Sinai before receiving the law of God is also false. His statement is, "In expounding Scripture we take thirty days as a month." For if every month is reckoned as thirty days, since there are twelve months in a year, there will be 360 days in a lunar year. But it is evident that this number is six days in excess. For it is agreed that in the lunar year there are only 354, since the solar year exceeds the lunar by eleven days, having 365 days. Therefore in two months there are only fifty-nine days. This is what Bede says in his book on Chronology, "I am disturbed by some anxiety in regard to the manner in which our ancestors compute the day on which the law was given, which is the third of the third month, the fiftieth from the slaying of the lamb. They maintain that there were seventeen days remaining of the first month, the thirteen preceding ones having passed before the passover, and an additional thirty in the second month together with three in the third, the total of which is fifty days. And let us rest assured that two lunar months contain not sixty but fifty-nine days; but that owing to this fact in the whole of the time mentioned there are found to be not more than forty-nine days." Such is Bede's statement. Therefore according to Bede the first day of June was not the forty-seventh but the forty-sixth, and thus if the law was given on the fiftieth day from the Passover, it was not given on the third day of the month of June, but on the fourth. But the Jews say that on the sixth day was the law given, and on the fourth day of their arrival in the wilderness of Sinai. For the Lord said, "Go to the people, and sanctify them today and tomorrow, and let them be prepared for the third day." And thus that third day was the sixth of their arrival; and according to this on the fiftieth day was the law given, not beginning from the Passover, nor from the first day of the feast of unleavened bread, but from the second day of this feast. This computation agrees with that made in the twenty-third chapter of Leviticus, "Ye shall count from the second day of the Sabbath, that is of the feast of unleavened bread, in which ye brought the sheaves of the first fruit seven full weeks to the second day of the completion of the

seventh week, that is, fifty days." Here, therefore, great perplexity is found among readers due to the error of the Master in the length of the month and in his own computation, as is clear to one giving this matter more careful consideration and from the fact that the reckoning of the Hebrews is unknown in these times. A table on lunar cycles harmonizes greatly the observances of the law. Since in accordance with that table it is necessary that, although the beginning of the year is, as a matter of fact, the lunation of October, yet due to the requirements of the law respecting feasts, they have a triple year; one the common year with 354 days, and one a lessened year with 353 days, and one a year in excess with 355 days; and thus the beginning of the year varies accidentally. This is necessary, because the year cannot begin on a Sunday. Since if it did begin on a Sunday, then on the fifteenth day of the seventh month it would be Sunday, and on the vigil of that feast branches of trees are collected, which is unlawful on the Sabbath. In like manner the beginning of the year cannot be either on Wednesday or on Friday. For if it began on Wednesday, then the tenth day of the month would fall on Friday, on which it is not lawful to do anything, since they are not permitted to prepare food, as it is equal to the Sabbath. Wherefore in that event they must needs prepare food on Thursday for Friday and for the Sabbath, which would be burdensome and tiresome, particularly in a warm region and in the hot season such as prevails in the land of the Hebrews. In the second place, if any one should die on Thursday, he would not be buried until Sunday, which would not be endurable in that country. If, however, the year began on Friday, then the tenth day would be Sunday, and the same inconvenience just mentioned would ensue, because there is no difference whether the tenth day precedes the Sabbath or follows it. Wherefore one must know thoroughly the table and the other matters connected with it if he wishes to have an understanding of the law.

But matters of greater importance are here in doubt, unless we are aided to the fullest extent by the power of astronomy. For questions arise contrary to the views of all Latin theologians. But owing to the importance of the matters I shall proceed in opposition to both sides, and let him rejoice in the solution who is able to give it. I shall not, however, make any

statement in opposition to the general opinions of the Latins except that which I know not how to answer. May I find some one to solve the difficulty, if the conclusion is false. But if, however, it should prove to be the true one, then a solution would not be necessary. But no one is of sufficiently great authority in the Church, except the Pope, to venture to give an opinion in opposition to the received opinions of the Latins in this matter, although they were false. The majority of Latins then hold that the Lord was born in the second year of a nineteen-year cycle and in the tenth year of a solar cycle, and in these matters there is no doubt, and that he suffered on the eighth day before the Calends of April [March 25] and that the moon was the fifteenth on the day of his Passion, matters concerning which there is a great dispute, and the Latins contradict the Greeks, who have maintained that the Lord suffered when the moon was at the fourteenth day. All the masters state this, and Augustine, Jerome, and Bede give authorities for this view. Opposed to it there is a strong argument. For if he suffered on the eighth day before the Calends of April and the moon was the fifteenth, this cannot be a fact, as Bede writes in his book on chronology, unless it was the thirteenth year of a nineteen-year cycle; and this is true. Because in accordance with this fact the golden number must have been thirteen, so that the moon may be named the first in the Calendar, where the thirteen are written, in order that from that place the age of the moon may be computed, so that it may be found to be the fifteenth on the eighth day before the Calends of April; as any one can find in the calendar. But since the Lord was born in the second year of a cycle, then at the end of that first cycle, he had lived eighteen years, according to the cycle, to which if we add from the second cycle the thirteen which passed up to his Passion, there will be thirty-one years according to cycles. But these years according to cycle are only twenty-nine years of his life, and of the thirtieth year the space of time from the nativity to the Passion; since he was born near the end of the second year of the cycle, that is, only seven days before the beginning of the third year, because the year begins at the Circumcision of the Lord. Wherefore at the end of the first cycle Christ had lived only seventeen years and seven days of his life, to which if there be added thirteen of the second cycle, there will be thirty; so that

his Passion was in his thirtieth year. Therefore the Lord lived only twenty-nine years, and so much of the thirtieth as remained up to his Passion; which is contrary to the Gospel of Luke, who states, John the Baptist baptized Jesus "beginning to be about thirty years of age." And again according to the word of the Evangelists it is certain that he preached for several years.

Thus Bede tries to prove that in three years and a half past the thirty, that is, in his thirty-fourth year according to him, he suffered, namely, in the eighteenth year of Tiberius Caesar. And another stronger objection follows; for if he suffered on the eighth day before the Calends of April and the moon was the fifteenth, then, as stated above, the golden number was thirteen; but the Latins in general follow the blessed Dionysius, the Roman abbot, who was the first to reckon years from Christ, while formerly they were reckoned from the time of the sacrilegious Diocletian, as Bede writes, and this is a fact; so that at the completion of the five hundred and thirty-first year from the Incarnation or Nativity he began to form his great cycle, which contains 532 years, resulting from the multiplication of the nineteen-year cycle and the solar one. He begins his cycle from the five hundred and thirty-second year after the Incarnation, and not from the five hundred and thirty-third, because the Lord was born in the second year of a cycle, and therefore of necessity the new cycle began from the five hundred and thirty-second year, that is, at the completion of the five hundred and thirty-first year from the Nativity. Bede shows that it was so much. For he says, "Dionysius writes paschal cycles, beginning with the five hundred and thirty-second year of the Incarnation of our Lord." If, therefore, we find the letter in the table, and revolve from this the cycle of Dionysius twice and as much beyond this as there is up to the present year from the Nativity of our Lord, we shall find that the eighth day before the Calends in the Passion is on Sunday, as any one can find out. But it is clear that he did not suffer on a Sunday, but on a Friday. Wherefore many men diligent in chronologies, but particularly Bede, Marianus Scotus, and Geraldus, famous among them all, leave us a very great doubt as regards the computation following the cycles of Dionysius. For Bede says to the computer, "Return thanks to God, if in this

way you shall find the year of our Lord's Passion. Wherefore if you do not discover it, ascribe your failure to the negligence of the chronographers or to your own stupidity." Men oppose him in two particulars; first, because he maintained that the Lord was born in the second year of a cycle; and, secondly, because he maintained that exactly the five hundred and thirty-first year had passed since the Incarnation or Nativity of the Lord.

Marianus, therefore, in his Chronicles concedes that it can happen and is a fact that the fifteenth moon may fall on the eighth day before the Calends of April, and the year be the thirteenth in the years of the cycle. But in that event it will be either the twelfth year of the life of Christ, or in the two hundred and fifty-ninth year; but he suffered neither in the twelfth year of his life nor in the two hundred and fifty-ninth year. Wherefore it does not seem that Dionysius can be proved correct. Therefore Marianus, carefully keeping in mind the failure of Dionysius, yet wishing to safeguard the view of Augustine and Jerome, says, because he suffered on the eighth day before the Calends of April, and likewise because the moon was the fifteenth, but not in the second year of a nineteen-year cycle, but in the eighteenth, two years of Christ must be taken from that cycle, so that the eighteenth year of the cycle is Christ's first year and the nineteenth is his second year, and then another whole cycle, which added together make the twenty-first year. Then thirteen from the third cycle should be added and the result will be thirty-four according to cycles. But the years of Christ's life are fewer than this, namely, thirty-two years and three months, and agree well with this number. Therefore Marianus added twenty-two years to the time of Dionysius. Therefore in our computation from Christ, if we wish to follow Marianus, we shall always add twenty-two years more than the Church reckons according to Dionysius. But according to Bede and according to the certain computation of the years of the emperors, it is evident that Marianus is in excess. For according to him from the birth of Christ to the cycle of Dionysius are 553 years; because to 531 he adds 22. But it was shown above that from the Incarnation of Christ to Dionysius there were not so many years, but only 531. For however liberally the years of the emperors are reckoned, we shall find that he

is in excess 22 years, or 21, or at least 20, and therefore is not to be imitated. Marianus is shown also by the blessed Augustine to be in excess. For Augustine says in the eighth book on the City of God, "Thus are reckoned 365 years from the passion of Christ to the consulship of Honorius and Euticianus." Therefore that year, namely, the consulship of Honorius and Euticianus, is the three hundred and ninety-seventh from the Nativity. This number is found by adding the years from the Nativity to the Passion, namely, thirty-two years according to Marianus and three months according to the computation above; but according to the computation of Marianus, as he himself has maintained in his Chronicles, it was the four hundred and nineteenth year. It is manifest then that he is in excess 22 years. For if you take 22 years from 419, there remain 397.

Moreover, the famous Gerlandus, whom all computers and astronomers follow in handling matters relating to computation, seeing that Dionysius cannot be proved correct nor his followers, being unwilling also to adhere to Augustine and Jerome as regards the day of the month on which the Passion occurred, but adhering to the blessed Theophilus, a contemporary of the Apostle, in his statement that the Lord suffered on the tenth day before the Calends, took from the computation of Dionysius seven years, and maintained that the Lord suffered in the ninth year of a cycle. For while Dionysius maintained that the Lord was born in the second year and took one year of the cycle from the Nativity, Gerlandus takes away that one and two to eight inclusive. Therefore the Lord was, according to him, eleven years of age at the completion of that cycle, to which if there are added one whole cycle and five years, because five is the golden number so that it may be the fifteenth moon at that point, there will be thirty-five years according to cycles, and these agree well with the years of our Lord's life. But just as Marianus was in excess, so is Gerlandus deficient. For by the computation submitted above according to Bede, and according to the years of the emperors, from the Nativity of the Lord there are only 531 or about that number, so that at the least Gerlandus is deficient five years, however liberally we compute the years of the emperors.

The Master in the Histories adds to the doubts of the others

a new question of doubt. For when he says at the end of his chapter on the Lord's Supper, "If we revolve the table of reckoning, we shall find the moon to be the twenty-second on the Calends of April and Friday at the time of the Passion; therefore the eighth day before the Calends of April was the fifteenth moon and a Friday," he is in manifold error. For if his opinion were the correct one, the golden number would be thirteen, and in that case, just as we have shown above, he would have suffered before the completion of thirty years, which is false. Likewise if we revolve the table, as the Master says, we shall find G to be the dominical letter at the time of the Passion and G to be on the eighth day before the Calends. Wherefore he suffered on Sunday, which is not true and contrary to the Gospel. But many, as Bede writes, and in particular Victorius, as is evident in his letter to Pope Hilary in regard to the paschal observance, say that Christ suffered on the seventh day before the Calends of April and rose on the fifth. But then, as Bede says, it must have been the second year of a nineteen-year cycle, because the golden number will be binary; on the supposition that the Lord suffered on the day of the fifteenth moon, as has always been assumed in the former calculations. But because he maintained that he suffered in the fifteenth year of Tiberius, as is manifest from his works, he is rightly refuted by Bede and by others.

These matters then have been discussed in accordance with the point of view of the writers on chronology, all the conclusions of whom are based on the assumption that it was the fifteenth moon on the day of the Passion. But astronomers anxious in this matter are not able to find the fifteenth moon nor the eighth day before the Calends at the time of the Passion, nor the tenth nor the seventh, so that at the same time it may be found to be a Friday, as it must be according to the Gospels, nor also from the thirtieth year of the Lord to the end of his life can they find it on any day of the month. Besides, there is the gravest doubt in this matter. For I have discussed these matters diligently both independently and in accordance with the consensus of those expert in astronomy. But with respect to the fourteenth moon it is readily found. Wherefore many things according to Scripture are to me and to many incontestable in this matter to the contrary, by which it is shown

that he suffered on the day of the fourteenth moon, just as the Greeks maintain and the Jews agree. For it is said in Matthew "Not on the feast day." But the feast day is the day of unleavened bread, which was at hand, and the day of unleavened bread is the fifteenth. Therefore he was slain before it. Likewise John in the eighteenth chapter, "They did not enter into the praetorium, that they might not be defiled but might eat the Passover." Therefore they ate the Passover on the next evening; if then Passover is here understood as the paschal lamb, on that evening began the fifteenth day, and the moon was the fifteenth, and then was so reckoned. Therefore before that evening was the fourteenth moon. Wherefore the Lord was slain on the fourteenth day of the moon, like the paschal lamb in the law. The statement, moreover, that Passover is not to be understood in this passage in the sense mentioned but otherwise, can have no authority from Scripture, and therefore is rejected with the same ease according to Jerome as that with which it is proved. But when they say that passover is to be taken here as unleavened bread, it is impossible. For unclean persons, although forbidden to eat the Passover, that is, the paschal lamb, were not, however, forbidden to eat unleavened bread, if after eating the lamb they became unclean. Nay, if any one should eat leaven, the law declares, Exodus XII, that he should perish from the assembly of Israel. Moreover, neither was leaven found in their houses during those days, wherefore they would not in the case supposed eat bread for seven days, which is wholly absurd. Wherefore this interpretation has no weight. Likewise John XIX, "It was moreover the preparation of the Passover." Therefore on the same day at evening they prepared the Passover. But when they prepared the Passover, the fifteenth moon was beginning. Therefore since he suffered before that day, it was the fourteenth. Likewise in the same chapter John says, "There laid they Jesus therefore because of the Jews' preparation day; for the sepulchre was nigh at hand." For on this account did they hasten to bury him lest they should bury on the fifteenth day, for they would not have buried him on the day of unleavened bread, because they buried no one on noted feast days like the Passover, Pentecost, Feast of Tabernacles, and the like. So too Luke XXIII, "And women returning," namely, on the day of the Crucifixion, "prepared

spices and rested the Sabbath day according to the commandment." Therefore that day was not the day of unleavened bread, but was the fourteenth; for it was unlawful for them to prepare spices on the day of unleavened bread. For in Exodus XII concerning the first and the last day of unleavened bread, it is said, "No work shall ye do in them save that which every man must eat." For as they would have rested on the Sabbath day because of the commandments, so would they have rested on Friday if it had been the day of unleavened bread. For the injunction refers to both, although the Sabbath is the more holy. Augustine in his book on Questions of the New and the Old Testament says that he suffered on the day of the fourteenth moon. These and many other statements can be here adduced together with the exclusion of false arguments.

But let these statements now suffice to arouse us to two efforts, namely, that we should know on what day of the moon the Lord suffered, whether the fourteenth or the fifteenth, and if one of these be settled upon, then that the day of his Passion should be discovered by means of astronomical tables, as has been indicated. But all these matters have very great difficulty, yet more so for this reason, because theologians are ignorant of astronomy and computation and the like, rather than owing to the difficulty of the thing in itself. For if they were expert in these subjects, they would easily discover with certainty the age of the moon and the day of the Passion, and they would change many opinions which they hold. For the most skillful in the consideration of those matters hold that the Lord suffered on the day of the fourteenth moon. This being verified, it is easy to find the Calends by special tables compiled for this purpose. To the intent that our mind may be aroused to do this, I shall here place a table in which, according to the tables of new moons, is found the opposition of the sun and moon through all the years of our Lord up to 38, so that we may see in what year it happens in March near the Passion of our Lord and in what year in April. Not, however, because of a certification of this matter am I giving this table, but as an example, in order that the method of argument in this particular may be made plain; for a certification is very difficult, for this reason, because the motions of the heavens have not been completely ascertained, nor do any tables whatever suffice

in this case. For many skilled in astronomy have labored in this matter, that they might find these oppositions of the sun and moon, and have not been able to find the year of the Passion from the thirtieth to the thirty-fifth, when there would be in March an opposition on a Friday, nor a day before the opposition nor a day next after it, so that it would agree with the Passion. Nor have I been able to discover it up to the present time. Where, however, an opposition together with a Friday can be found according to the present table, will be disclosed by an explanation of it.

Explanation of the Table.

The first line, then, occurring in the table below contains the years of our Lord to the thirty-eighth; because it is certain that he suffered within those years. The second line has all the letters of the sixth week day, which happened in those thirty-eight years. The third line contains the days next before the opposition of the sun and moon. The fourth, the day of the opposition. The fifth, the day immediately after the opposition. The sixth, the day following, and here is found the mean opposition of the sun and moon. The seventh line, with those joined to it, contains the time passed in March before the day of the Passion. The rest of the table deals with April, so that the opposition may be found in April around the day of the Passion, with the exception that it occurs in the seventeenth and thirty-sixth years in March. We must bear in mind, however, that these tables were made for the meridian of the city of Novaria, although constructed at Paris; but there was a reason, for Novaria is more out of the way, and noon there precedes the noon of Paris by twenty-five minutes of one hour. If, therefore, from the given time we subtract twenty-five minutes, there will remain the time of the opposition after noon at the city of Paris. According then to this table the Lord suffered three days before the Nones of April on Friday at the mean opposition of the sun and moon in the fifteenth year of a nineteen-year cycle, and in the fourteenth of a solar cycle, in the thirty-third from the Incarnation according to the cycle of Dionysius, and that is, in the thirty-second year, according to the true age of the Lord. This in the second table occurs beyond the letter *b* in the

line of the thirty-third year after two days of April and seventeen hours and sixteen minutes and thirty-three seconds, fifty thirds, twenty-four fourths, and so the most expert in these calculations have reckoned, who have labored hard to prove this. Whence according to them the opinion of the Church that he suffered on the eighth day before the Calends of April is not verified by facts, but is the popular view, as is the case in many other matters which lack stronger verification. If, therefore, mean opposition and the fourteenth moon from its illumination occur together at the Passion, the matter is clear according to this table and according to the reckoning of learned men. If, however, the opposition precedes at the Passion the fourteenth moon by a whole day, it would be necessary to have recourse to a table of the illumination of the new moon constructed similarly to this one, and then doubt would be the more removed. But authorization of this view, as well as other matters of which I write, requires the assent of your Holiness, that those expert in such matters may firmly establish the truth. I have shown in this chapter how we can attest this matter, but I do not claim in the present treatise to have solved so great a difficulty myself.

It has been said that there are seven heads under which we must employ mathematics. One is in regard to celestial matters, another concerning places in the world, the third concerning chronology as regards its substance, the fourth concerning the qualities and accidents of chronology, of which mention has been made. Now I wish to present the fifth head, which concerns geometrical forms as regard lines, angles, and figures both of solids and surfaces. For it is impossible for the spiritual sense to be known without a knowledge of the literal sense. But the literal sense cannot be known, unless a man knows the significations of the terms and the properties of the things signified. For in them there is the profundity of the literal sense, and from them is drawn the depth of spiritual meanings by means of fitting adaptations and similitudes, just as the sacred writers teach, and as is evident from the nature of Scripture, and thus have all the sages of antiquity handled the Scripture. Since, therefore, artificial works, like the ark of Noah, and the temple of Solomon and of Ezechiel and of Esdra and other things of this kind almost without number are placed in Scripture, it is not possible for the literal sense to be known,

Anni Domini.	Literae sextarum feriarum.	Dies proximus ante oppositionem.	Dies oppositionis [et ideo passionis signum, et similiter in alia tabula].	Dies proximus post oppositionem.	Dies sequens proximum.	Post quot dies de Martio		
						Dies.	Horae.	Minuta.
1	g	b	c	d	e	27	14	31
2	f	e	f	g	a	16	23	19
3	e	b	c	d	e	6	8	8
4	c	f	g	a	b	24	5	41
5	b	b	c	d	e	13	14	29
6	a	e	f	g	a	2	23	18
7	g	c	d	e	f	21	20	51
8	e	f	g	a	b	10	5	39
9	d	c	d	e	f	28	3	12
10	c	g	a	b	c	18	12	1
11	b	c	d	e	f	7	20	49
12	g	g	a	b	c	25	18	22
13	f	c	d	e	f	14	27	11
14	e	g	a	b	c	4	11	59
15	d	e	f	g	a	23	9	32
16	b	g	a	b	c	11	18	21
17	a	d	e	f	g	1	3	9
18	g	b	c	d	e	20	0	42
19	f	e	f	g	a	9	9	31
20	d	b	c	d	e	27	7	3
21	c	e	f	g	a	16	15	52
22	b	b	c	d	e	6	0	41
23	a	f	g	a	b	24	22	13
24	f	a	b	c	d	12	7	2
25	e	e	f	g	a	2	15	51
26	d	b	c	d	e	20	13	23
27	c	f	g	a	b	20	22	12
28	a	c	d	e	f	10	19	45
29	g	g	a	b	c	28	4	33
30	f	c	d	e	f	18	13	22
31	e	a	b	c	d	7	10	55
32	c	c	d	e	f	26	19	43
33	b	g	a	b	c	14	4	32
34	a	e	f	g	a	4	20	5
35	g	a	b	c	d	23	10	53
36	e		d	e	f	0	19	42
37	d	a	b	c	d	19	17	15
38	c	e	f	g	a	9	2	3

Principium cycli alia via, sc. rationis.

Principium cycli secundum computistas.

Hic.

Quarta.	Dies proximi ante oppositionem [mediam].	Dies oppositionis mediae.	Dies proximi post diem oppositionis mediae.	Secunda dies post diem oppositionis.	Post quot dies de Aprili et quot horas et minuta et tertia fuit media oppositio, quantum ad meridiem Novariae; tamen in duobus annis, 17. sc. et 36. ponitur post quot de Martio; et secundum hanc computationem incipit dies in medio diei praecedentis, et terminatur in medio sui.					
0	d	e	f	g	26	2	55	5	15	44	April.
48	g	a	b	c	15	12	3	44	24	32	April.
36	c	d	e	f	4	20	52	23	33	20	April.
8	g	a	b	c	22	18	25	5	57	52	April.
56	d	e	f	g	12	3	13	45	5	40	April.
44	g	a	b	c	1	12	2	24	15	28	April.
16	e	f	g	a	20	9	35	6	40	0	April.
4	g	a	b	c	8	18	23	45	48	48	
36	d	e	f	g	26	15	56	28	13	20	
4	b	c	d	e	17	0	45	7	21	48	
12	e	f	g	a	6	9	33	46	30	56	
44	b	c	d	e	24	7	6	28	55	28	
32	e	f	g	a	13	15	55	8	4	16	
20	b	c	d	e	3	0	43	47	13	4	
52	f	g	a	b	21	22	16	29	37	36	
40	b	c	d	e	10	7	5	8	46	24	April.
28	e	f	g	a	30	15	53	47	55	12	Mart.
0	c	d	e	f	18	13	26	30	19	44	April.
48	f	g	a	b	7	22	15	9	28	32	
20	c	d	e	f	25	19	47	51	53	4	
8	g	a	b	c	15	4	36	31	1	52	
56	c	d	e	f	4	13	25	10	10	40	
28	a	b	c	d	23	10	57	52	35	12	
16	b	c	d		10	19	46	31	44	0	
4	g	a	b	c	1	4	35	10	52	48	
36	d	e	f	g	19	2	7	53	17	20	
24	a	b	c	d	9	10	56	32	26	8	
56	e	f	g	a	27	8	29	14	50	40	
44	a	b	c	d	16	17	17	53	59	28	
32	e	f	g	a	6	2	6	33	8	16	
4	b	c	d	e	34	23	39	15	32	48	
52	e	f	g	a	13	8	27	54	41	36	
40	a	b	c	d	2	17	16	33	50	24	
12	f	g	a	b	21	14	49	16	14	56	
0	b	c	d	e	10	23	37	55	23	44	April.
48	e	f	g	a	30	8	26	34	32	32	Mart.
20	c	d	e	f	18	5	59	16	57	4	April.
8	f	g	a	b	7	14	47	56	5	52	

unless a man have these works depicted to his sense, but more so when they are pictured in their physical forms; and thus have the sacred writers and sages of old employed pictures and various figures, that the literal truth might be evident to the eye, and as a consequence the spiritual truth also. For in Aaron's vestments were described the world and the great deeds of the fathers. I have seen Aaron thus drawn with his vestments. But no one would be able to plan and arrange a representation of bodies of this kind, unless he were well acquainted with the books of the Elements of Euclid and Theodosius and Milleius and of other geometricians. For owing to ignorance of these authors on the part of theologians they are deceived not only in matters of the greatest importance, but also in those of very little consequence. For they state along with the Master in the Histories that the small balls of the candlestick were circular bodies not possessing full sphericity. The use of the diminutive in speaking of them is not for this reason, but because they were small balls, yet satisfying completely the definition of the sphere in Euclid and Theodosius. For the Jews in their Gallic speech call those small balls *pumeus* from the roundness and sphericity of the *pumel,* and so too concerning other things without number. Oh, how the ineffable beauty of the divine wisdom would shine and infinite benefit would overflow, if these matters relating to geometry, which are contained in Scripture, should be placed before our eyes in their physical forms! For thus the evil of the world would be destroyed by a deluge of grace, and we should be lifted on high with Noah and his sons and all animate creatures collected in their places and orders. And with the army of the Lord in the desert we should keep watch around the Tabernacle of God, and the table of the shewbread, and the altar, and the cherubim overshadowing the mercy seat, and we should see as though present all the other symbols of that ancient people. Then after the unstable tabernacle swaying to and fro had been removed, we should enter the firm temple built by the wisdom of Solomon. And with Ezekiel in the spirit of exultation we should sensibly behold what he perceived only spiritually, so that at length after the restoration of the New Jerusalem we should enter a larger house decorated with a fuller glory. Surely the mere vision perceptible to our senses would be beautiful, but more beautiful since we should see in our presence the form

of our truth, but most beautiful since aroused by the visible instruments we should rejoice in contemplating the spiritual and literal meaning of Scripture, because of our knowledge that all things are now complete in the Church of God, which the bodies themselves sensible to our eyes would exhibit. Therefore I count nothing more fitting for a man diligent in the study of God's wisdom than the exhibition of geometrical forms of this kind before his eyes. Oh, that the Lord may command that these things be done! There are three or four men who would be equal to the task, but they are the most expert of the Latins; and rightly must they be expert, since unspeakable difficulty lurks here, owing to the obscurity of the sacred text and the contradictions of the sacred writers and differences of the other expounders.

But in another manner the usefulness of geometry is disclosed as regards sacred knowledge, both in the text and in the questions: and not only in these, but in beautiful comparisons respecting grace and glory and future punishment, and precaution against vices. Concerning each I shall give an example. And for the sake of all things in general let us recall to mind that nothing can be known concerning the things of this world without the power of geometry, as has already been proved. Also a knowledge of things is necessary in Scripture on account of the literal and spiritual sense, as has been set forth above. For without doubt the whole truth of things in the world lies in the literal sense, as has been said, and especially of things relating to geometry, because we can understand nothing fully unless its form is presented before our eyes, and therefore in the Scripture of God the whole knowledge of things to be defined by geometrical forms is contained and far better than mere philosophy could express it. Nor is it strange, since God himself, the author of all wisdom, has ordained his own Scripture. Wherefore in place of an infinite number of examples I desire at present to cite one. For Aristotle more than all other philosophical writers has involved us in obscurities in dealing with the rainbow, so that we secure no valuable information through him, nay, many false statements are contained in the translation of the Latins, as we maintain from the differences of the expounders. For the statement made in the editions of the Latins that the rainbow occurs only twice in fifty years in the rays of the moon, is manifestly false, as any one can dis-

cover in full moonlight when it rains provided the brightness of the moon is not lessened by the density of the clouds. Avicenna, moreover, the greatest authority in philosophy since Aristotle, as all insist, humbly confessed that he himself was ignorant of the nature of the rainbow. Thus it is certain regarding all philosophers that no one of them has been able to gain a knowledge of the rainbow. Nor is it strange, since they have not examined Scripture with the necessary diligence. For all philosophers have been ignorant of the final cause of the rainbow. But the end places a necessity on those things concerned with the end, as Aristotle says in the second book of the Physics, and it is a fact in all matters. Now the end for which the rainbow exists the text of God alone explains clearly, namely, when it is said, "I shall set my bow in the clouds of heaven," etc. From which the fact is established that God's bow was provided against a deluge and an overflow of the waters. Therefore of necessity, whenever this bow appears in the heavens, there must be an active consumption of the aqueous moistures; and this is a fact. For the clouds are freely resolved, and dew falls are produced without number, as the philosophers say, and we see in great part. But the consumption of the aqueous moisture does not happen except by means of something possessing the power to consume. But we find nothing in the production of the rainbow except the rays of the sun and the clouds. The collecting of the clouds is the material cause; therefore the projection of the rays is the efficient cause. But the incident rays cannot effect great and wonderful results, because they do not mutually converge; a convergence, moreover, of forces is required that a vigorous action may result. But convergence can occur only through reflection and refraction. Wherefore the rainbow must be produced by infinite reflections or refractions in numberless drops of water falling without an interval, so that the truth is thus discovered regarding both its colors and form by means of multiplications of this kind in respect to figures, angles, and lines, and not by means of a diversity in the matter forming the cloud, as is stated in the text of the Latins and as all believe, even as I shall explain by certain experiments when I mention the subject of experimental sciences. Just as philosophers, then, owing to their ignorance of the sacred Scriptures have been unable to know the truth regarding

the rainbow, so in the same way it is impossible for the unbelieving philosopher to reach full certainty in regard to any creature owing to ignorance of the Scripture. For in truth each creature is entered there according to its ultimate dignity, namely, according to its true definition and description, because God made the creatures he has placed in the Scriptures, and he himself alone knows them as they are. Since, therefore, the power of geometry is required for the knowledge of every corporeal creature, there is no doubt but that in an inexpressible manner it is effective for sacred knowledge because of its aid in understanding things.

But returning to the proposition considered in a spiritual sense I offer an example from Scripture, which says, "The sun in a threefold manner burns up the mountains," etc. For infinite rays fall upon every point of the mountain because infinite rays come forth from every point of the sun, and light is the cause of heat, especially when there is convergence, as we sensibly know, and an infinite number of rays is reflected from the surface of the mountain, because reflection takes place from a dense body, and the rays converge at every point in the air, and draw apart at every point of the air, rarefying the air near mountains, and thus, secondly, do the mountains grow hot. Through the medium of the clouds the rays are doubly refracted, first at the surface of the clouds toward the sun, then in the air between the clouds and the mountains. By this double refraction all rays of the sun coming from one point must converge to a point on the mountain or in the air near the mountains, particularly in very lofty mountains and in the Alps.* Thus heat is produced on mountains, although not on the loftiest mountains; since mountains rising to the clouds or nearly so, like the mountains of Italy and Spain and the Caucasian and Caspian range and innumerable other mountains, are very cold and have almost perpetual snows; because they approach too near to the mid-space of the air, which is the coldest place in this world. Thus from the separate points of the sun rays proceeding and doubly refracted increase and augment the heating of the mountains. All these things are made clear by means of mathematical forms, as is the case in the round beryl, or crystal, or water container, or any transparent body thicker

* *I.e.*, lower mountain pastures. See Bridges' note on this passage.

than air. For when these bodies meet the solar rays, owing to the double refraction a point in the air sensible to sight and touch can be selected, at which dry tow or some other very combustible substance may be set on fire, as has been stated before. This triple heating can be called a threefold combustion, of which the Scripture speaks; or otherwise we can say that it causes a single combustion of the mountains from the three sources of which Scripture speaks when it states, "The sun in three ways consumes the mountains." For in another way combustion is considered with regard to the different kinds of angles, because the multiplication of light is either at right angles, or oblique, or at no angles. If at oblique angles, there is vigorous action; if at right angles, the action is stronger by the eighteenth proposition of the first book of Euclid's Elements and by other methods; if at no angles, there is the strongest action because of the equality in every way, as has been stated above. But from every point of the sun to every point of the mountain exposed to the sun the rays come, and they fall in infinite numbers at right angles, and in infinite numbers at oblique angles, as is clear. Although, moreover, the surface of the mountains is not everywhere polished and smooth, nor spherical, yet in many parts of it is it of such a character, and infinitely so throughout different small portions and therefore by taking into account sphericity of this kind an incidence of rays takes place at no angles, and for this reason there is a triple incidence. Wherefore there takes place a triple falling of rays as regards the angle and the absence of angle. In all ways is there heat produced by the incidence of light and its convergence. Wherefore the second manner of combustion of which the Scripture speaks can be explained in this way now mentioned. In the third place, the falling of light varies as regards its figures, for it falls in a spherical form and in a pyramidal one, of which the apex is on the sun and the base is on the mountain, and in a pyramid of which the apex is at a point on the mountain and the base on the sun. In all these three ways there is formed a multiplication of light from the sun on the mountain, as is certain from what has been said above, although the spherical multiplication of light can be strong, yet the pyramidal multiplication, of which the apex is in the sun, is stronger; and the pyramidal one, of which the apex is at a

point of the mountain, is strongest, because, as has been said, by that pyramid from the whole surface of the sun opposite to the mountain light comes to every point of the mountain, since the base of that pyramid is the surface of the sun, and an infinite number of such pyramids come from the same surface of the sun, as is evident to one drawing a figure. Nature does not require more figures in the multiplication of light, or in the multiplication of any force or species, in order that by any agent soever there may be formed a species to be multiplied, as he knows for a certainty who is acquainted with the paths of nature through the potency of geometry. By these three multiplications pictured there arises the third combustion of which the Scripture speaks. But these matters cannot be known, unless a man has an excellent knowledge of the potency of geometry.

Owing to the questions arising I offer one example instead of a thousand, where the power of geometry is required, although the rank and file do not perceive it. For concerning light and its multiplication theologians ask many questions, namely, whether it is a substance or an accident, whether it is a body in a medium, whether suddenly or successively it travels in a medium, etc. But these matters in no way can be known without what has been said concerning multiplication according to lines, angles, and figures. For the multiplication of light is just like the multiplication of every other species of any agent whatsoever. For light in a medium is the species of the light that is in the luminous body. Therefore the rules that were stated concerning the multiplication of species taken generally are understood in the case of light and in the case of any determined species whatever. Since, therefore, the multiplication of species taken absolutely requires the greatest geometrical power, as has been abundantly shown previously, it is manifest that the same power of geometry is necessary to understand the multiplication of light, although theologians do not employ it.

Then regarding the expression of spiritual matters by means of geometrical truths, I offer an example in grace and in glory, both in the case of those to be saved and those to be damned, in order that we may see how lines straight, broken, and reflex, may be adapted to spiritual matters of this kind. Since the infusion of grace is very clearly illustrated through the multi-

plication of light, it is in every way expedient that through the corporeal multiplication of light there should be manifested to us the properties of grace in the good, and the rejection of it in the wicked. For in the perfectly good the infusion of grace is compared to light incident directly and perpendicularly, since they do not reflect from them grace nor do they refract it from the straight course which extends along the road of perfection in life. But the infusion of grace in imperfect, though good men is compared to refracted light; for owing to their imperfections grace does not continue in them an altogether straight course. But sinners, who are in mortal sin, reflect and repel from them the grace of God, and therefore grace with them is compared to light driven away or reflected. But as of bodies from which light is reflected, some are rough, from which the reflected light is dissipated and does not appear; and others are polished and of an equal and smooth surface, from which there is produced a sensible reflection, as in the case of mirrors; so sinners living in mortal sin are of two kinds. For there are some who so repel grace that nothing good appears in them, but respecting them and those nearest it is manifest that the whole effect of grace is dissipated in them, and these men are the openly evil who do not hide their sins. There are others, however, who, although they are not good, yet hide their sins, and appear good in the sight of men, as do the hypocrites. This comparison can be made also in another way. For sinners in this life are compared to reflecting bodies, as has been said, and men in grace in this life are compared to those bodies in which there is a refraction of light because of the imperfections of human frailty, because however perfect a man may be in this life, yet has he many obliquities, and imperfect in him are the love and knowledge of God. But those living in the kingdom are compared to those things that receive the light within in a straight course without deviation, as far as is possible in a creature, and as far as the order of divine justice exacts, which returns to every man according to his deserts. Since, however, the damned wholly lack the grace and glory of God, and the glorified are in a measure imperfect on the score of imperfection in merit in many things and in accordance with the law of creation (since every creature has imperfection with regard to the glory of its Maker), there can

be a third comparison according to the status of the damned and of the glorified and of God, so that to the damned the comparison of reflected light is wholly applicable, and in regard to the glorified the simile of refracted light is appropriate, and the utmost rectitude and perfection of the divine glory are symbolized by the direct course of light, in which way a better proof is given of the trinity and unity of the persons of the Godhead. Such a comparison we make according to our ability and to the extent that we are permitted to set forth by means of creatures the attributes of the Creator.

I shall add what should be carefully noted, that it is impossible for the blessed trinity and unity of essence to be represented more aptly by us in an example of a creature perceptible by the senses than by means of matters pertaining to geometry. For in the triangle alone among all things made is there found a unity of essence with the distinction of three embracing the same essence. Since each of the three angles occupies the same identical space and the whole of it, as is evident to the sense, and yet they are in fact distinct angles, which is wonderful in a creature, nor is it found elsewhere except in the supreme Trinity. And when on a given line it is required to construct an equilateral triangle, as the first proposition of Euclid states, what can be assumed more properly in order that we may perceive that if the person of God the Father be granted, a trinity of equal persons presents itself?

These matters and many like them can be made available as salutary wisdom from the truths of geometry, and especially so from the tenth book, where the rationality and commensurability of quantities are set forth. For these subjects can be adapted in a useful and excellent way to sacred matters and to the figurative representations of the virtues with the exclusion of the vices. For whatever is contained in that book regarding rational quantities can be applied to a life which consists in virtue; and that which is explained regarding irrational quantities can be likened to the irrational and bestial morals of sinners. Whatever also is said concerning the commensurability of quantities can be fittingly applied to the acts of love; and what is set forth concerning incommensurability is known to relate to hate and the separation of souls. But these matters require a longer discussion. Moreover, in precaution against sins

we are greatly aided by the consideration of this kind of geometrical multiplications. For since the delectable things of this world are to us like mousetraps, by which we are made captives to sin, as is written in the book of Wisdom; and like bait on the devil's hook, with which we would be strangled except in so far as God deigns to guard us, and our senses carried away in regard to the delectable things announce to our intellect an occasion of sin, the first and principal remedy existing in man is not to receive according to their principal multiplication into his five senses the species of delectable things, as of women and foods and riches, things in which human desire is at boiling heat and proud ambition glories; for the accidental multiplication suffices a man for damnation when it is received eagerly and copiously. But still more to be avoided is the straight sensible multiplication than the refracted or reflected because of the stronger action previously explained. But most of all must we avoid letting the direct delectable species fall at equal angles into our sense, because then is it strongest, especially if the vertex of the short pyramid meets it. So Eve received the species of the voice of the serpent and of the visible apple and its sweet odor; and Adam was tempted so that he damned himself and the whole human race because of the multiplication of species perceptible to the senses. So David the holy prophet deceived by the species of Bathsheba fell from adultery into murder. So the elders whom Daniel judged were deceived by the species of a woman. And it is certain that every man is deceived by the species of the things of this world, because, according to John, "all that is in the world is either the lust of the flesh or the lust of the eyes, or the pride of life," from the love of which no one can withhold himself, who delights in the sense of the species which come from things. For he is taken captive like a beast. Therefore men devoting themselves to holiness turn away their senses as far as possible from all species of delectable things, and especially from those pertaining to the sense of touch and taste, which are gluttony and excess, so that not only do they not touch, but do not see nor hear mention made of these things, lest the species multiplied into the senses should compel the spirit to serve carnal allurements; and particularly are they on their guard against proximity to them, so that they may avoid the shorter pyramids, and

multiplications, principal, direct, and at equal angles, as I have said before. These are most of all to be avoided when it is necessary either in confession or for some other reason to talk with women. For all men, however holy, strong species in this particular would disturb, although such species could not overcome those whom God deigns to guard.

We have now spoken of five heads of mathematics as regards Scripture; two others remain for us, namely, numbers and matters relating to music. Since, however, sacred writers abundantly show the utility of these subjects, and express more fully comparisons and praises of these with respect to sacred matters than they do with regard to the heads already considered, I have for this reason touched upon the others more fully, and in regard to these two I shall merely hint at certain methods, the explanation of which is found in the books of the sacred writers given in full. Numbers, in fact, are valuable for the sense of Scripture in four ways. For number was not placed in Scripture with any other purpose than that it should be taken in a literal sense according to all its arithmetical properties, to the end that through fitting similitudes the spiritual meaning may be elicited, just as the sacred writers make clear in almost endless ways. In the second place, for a knowledge and a certifying of chronicles it is necessary for the theologian to have ample ability in computing, so that he may know all the algoristic methods, not only in whole numbers, but in fractions, in order that he may know how to compute, add, subtract, halve, multiply, divide, and extract roots, both fractions and whole numbers: and again that he may not only know vulgar fractions as regards halves, thirds, fourths, fifths, and so on to infinity; but that he may know fractions used in astronomy, namely, minutes, seconds, thirds, fourths, fifths, and so on to infinity, because in these historical matters we must have recourse to the motion of the sun and moon, in which such fractions are in the main considered, concerning which sufficient explanation has been given above. One must know not only the fractions of the Latins and the Arabs, but also of the Hebrews, who divide the hour into 1080 parts, of which mention has been made before. But the man who has to use these must know how to reduce different kinds of fractions in turn; because if between whole numbers there occur seven fifths, and ten sevenths, and twenty

eighths, and the like in endless ways, a man cannot extricate himself, unless he reduces these different kinds of fractions to one kind of fraction, so that they may thus be reduced to whole numbers. But in using these fractions and whole numbers there is great subtlety, and the fair lights of wisdom shine out, especially since through these all knowledge sacred and human is directed and harmonized, in accordance with which two authorities, Cassiodorus and Isidore, have expressed themselves clearly, proving us guilty in a cruel fashion, because all ignorant of the potency of numbers, they assert, do not differ from brutes, which know neither sacred things nor human. In the third place, a consideration of numbers is valuable in Scripture, namely, in making division and distribution of the shares of booty and of portions to priests, to Levites, to princes, and to individuals, according to which Moses, most skillful in algoristic computations, distributed to each one what was his, distributing an almost countless number of things into parts most definitely determined by the nicest algoristic operations both in fractions and in whole numbers. No one can elicit the literal sense nor in consequence the spiritual, as the dignity of Scripture requires, unless he knows the reason for these operations and learns the methods in counting by which Moses and others in Scripture proceed.

In the fourth place, one must have an excellent knowledge of the methods of computation because of the corruption of numbers in the Scripture, since they are corrupted in almost endless ways; for almost all the numbers have been corrupted. This corruption cannot be reduced to truth except by means of the ability to compute in every way, both in fractions and in whole numbers. For nearly all numbers, or at least the major part of them, in the sacred text and in the books of the sacred writers have been perverted through the fault of scribes and amenders, of which I shall furnish a few examples to serve for many. For in the eleventh chapter of Genesis it is stated, "Arphaxad lived after he begat Salah three hundred and three years." But in the Hebrew the years are given as 403. From the Greek moreover the truth cannot be ascertained because between Arphaxad and Salah it places Cainan, whom we do not have, nor does the Hebrew. And in the same chapter, Reu lived thirty-two years according to the Hebrew and ancient

codices of the Latins. But in the vulgar edition the years are given as thirty-five, so that the true account of the chronicle cannot be a continuous one. In the eighteenth chapter in the part near the end, "Peradventure there shall lack five of the fifty righteous; wilt thou destroy for the lack of five?" Thus read the Hebrew and the ancient books. Modern correctors have inserted forty-five for the sake of clearer sense. But it is not lawful without approval of the apostolic seat to change the text which it has received and ordered distributed through all the churches. And in the thirty-seventh chapter, "Joseph, when he was seventeen years old," according to the Hebrew and the Greek. But modern amenders have sixteen, and that in the same chapter he was not sold for thirty pieces of silver, but for twenty, has been proved above on ample testimony. And in the fourteenth chapter of Exodus, "and he took six hundred chariots," according to the Hebrew and the Greek and Josephus and the ancient codices. But part of the gloss mutilated in nearly all books causes the vulgar edition to read three hundred chariots. For in general this much only is given in the gloss, "in order to fight against the faith of the Trinity." Whence owing to the name of the Trinity they rubbed out the six hundred and inserted three hundred. But in many ancient glosses the statement is found as follows, "to fight against the faith of the Trinity he armed himself with the number six." Therefore according to the gloss six hundred can be read in this passage. In the thirty-second chapter of Exodus the Hebrew and the Greek read, "about three thousand." But the vulgar edition has twenty-three thousand. The Master in the Histories says that this is from an ancient translation. But the ancient translation is that of the Seventy, and is from the Greek, but the Greek does not read thus, nor does the Hebrew. This error has its origin in the tenth chapter of the first epistle to the Corinthians. But the statement there is not to be understood as referring to this passage, as is clear in the text and in the gloss. Since when he says, "Neither be ye idolaters," etc., he does not give the number of slain, because the words do not refer to this passage. But immediately when he says, "Neither let us commit fornication," etc., he continues, "and fell three and twenty thousand," which statement is understood according to the gloss in regard to those who committed fornication

with the Midianites, as we read in the twenty-fifth chapter of Numbers. I do not wish to heap up more examples at present, since it does not accord with my main purpose to prove corruption of the text. But I have introduced these examples, so that the necessity of computation in the Scripture may be seen, to the end that we may know how to correct the errors in numbers.

And still a fifth reason can be noted for the usefulness of numbers. For unity multiplied into itself cubically, that is, thrice, as once one taken once, does not multiply essence, but remains the same although it is produced equally in three directions. And so by a familiar example theologians designate the blessed Trinity. Moreover, although a manifold perfection of number is found according to which ten is said to be perfect, and seven, and six, yet most of all does three claim for itself perfection; since an especial perfection that is assigned to other numbers is that all the aliquot parts taken together should give its total, as is evident in the number six. But in the number three alone does it happen that the aliquot part and the non-aliquot part taken together give the number itself, namely, unity and two, a fact which cannot be discovered in any other number. And since in every number there are two things, namely, discreetness of parts and oneness from their union, because of which the number is said to be one: nor does anything else make a number except these two things; these two are found exactly in the number three. For by means of the two is there discreetness, and by means of unity is unity itself obtained. Therefore complete perfection of number is found in the number three and not in any other. For this reason this number befits the Creator more than any other. And as every large number proceeds from unity, so from God himself. Arithmetic at its end teaches how all the proportions are investigated in the ratios of numbers. For neither the geometrician, nor the musician, nor the astrologer treats of these, but applies what arithmetic, which is the science of numbers, teaches. Theologians, moreover, strive to exalt these proportions to the properties of the divine persons, and in particular Richard of Saint Victor in his book on the Trinity, which offers great difficulty on account of the ignorance of these proportions on the part of the majority. Many for this same reason abuse the com-

parisons of these proportions to sacred things. Now a proportion is of three kinds, namely, arithmetic, geometric, musical. The arithmetic proportion consists in the identity of the differences of the first to the second, and of the second to the third, as four, three, two. For unity alone is the difference from different directions, and a similitude to this is found in the divine persons. For the difference of the Father respecting the Son is that the Father gives to the Son and does not receive from him; and the Son conversely. Similarly between the Son and the Holy Spirit there is a like difference. For the Son gives to the Holy Spirit and does not receive from him; the Holy Spirit conversely receives from him and does not give to him. And since there is a geometrical proportion, when there is the same ratio of the first to the second and of the second to the third, an application of this mean is found by means of the perfect equality and unity of essence in the three persons, and in all their essential qualities, which are power, wisdom, goodness. For we believe and firmly hold that as is the Father, such is the Son, and such the Holy Spirit. The harmonic or musical proportion consists in the identity of the ratio of the first to the third, and of the difference of the first and the second to the difference of the second and the third, as six, four, three. For there is a double ratio between the first and the last; likewise between two, which is the difference of the first and the second, and unity, which is the difference of the second and the third. And thus is there found a similitude in the divine persons. For the same relationship exists of Father to Holy Spirit, since there is equality, as there is between the difference of Father and Son, and the difference of Son and Holy Spirit. For between Father and Son is the difference that the Father gives and does not receive, the Son receives and does not give; and this same difference exists between the Son and the Holy Spirit, as is evident. Thus then briefly are these proportions assigned, although in other ways also are they assigned by many whom I cannot understand; because I do not think that they can be justified by the principles of arithmetic. But the present occasion is not a fitting one to explain the opinions of individuals.

The sixth reason for the utility of arithmetic can be found in Scripture regarding things of this world which it employs. For it touches upon the height and magnitude and thickness

and number of the heavens and of the stars and requires certification in regard to them. The sacred writers in their expositions say many things regarding them. For Jerome says on Isaiah that Orion has twenty-two stars, of which the first nine are in the third magnitude, and nine of the remainder are in the fourth, and the last four are in the fifth magnitude, and does not explain himself. The theologian therefore ought not to be ignorant of these things. But especially in these matters does arithmetic give us correct notions, and I therefore wish to disclose these great truths by means of numbers, since the comparison of numbers appears to do so in an excellent and useful manner. Now for this consideration it is necessary to take some known base. This base is the length of the arc of the earth, which corresponds to one degree in the heavens, according to the teaching of Alfraganus in chapter VIII.

Averroës also agrees to this at the end of the second book of the Heavens and the World. These writers, in fact, give the method of verifying this in the number of miles and parts of a mile. Ptolemy, moreover, in the fifth section of the Almagest proceeds by means of an extended demonstration in regard to the altitudes of the sun and moon and in regard to their magnitude. But he does not give a definite quantity in number of miles; nor does he determine from other celestial bodies the quantity. It is necessary, therefore, to assume that a uniform and geometrical cubit contains a foot and a half, and that a mile contains 4000 cubits, and so Alfraganus takes them in his computation. Moreover, every circle of a sphere can be divided into 360 parts, which are called degrees. We are to understand, then, the largest circle in the celestial sphere, which passes through the center and divides the sphere into two equal parts. I say then that to one degree of this circle will correspond many miles on the earth, experimental knowledge of which Alfraganus hints at in the fact that if we take the elevation of the pole star above the horizon and walk to the north or to the south to a point where the pole star appears a degree more elevated or depressed, we discover the number of miles on the earth corresponding to one degree in the heavens. For if on a clear starry night one views through the apertures of a quadrant or an astrolabe or other instrument the star used by sailors, namely, the pole star itself, and notes the degrees that the end

of the rod on the back of the astrolabe or the filament on the quadrant reaches and then proceeds on the earth to the north until on another starry night he sees the same pole star to be elevated one degree higher above the horizon, that arc of the earth which he has traversed will correspond to one degree, and will be similar to it, as similar arcs are taken on different spheres according to Theodosius, but they will not on this account be equal.

Since, moreover, he teaches in the twenty-first chapter that the diameters of the celestial orbits and the distances of the auges and of the points opposite are measured by the semidiameters of the earth, which contain 3250 miles, it behooves him to take the true length of the semidiameter. For otherwise a great error would occur in the distances of the auges from the fact that the length of the semidiameter of the earth repeated many times would make a great error in those distances unless the exact length was taken. Since, therefore, we must grant that Alfraganus perceived this error, it is manifest that he himself takes the true length of the semidiameter, namely, 3250, and the true diameter, namely, 6500. Therefore he must of necessity assume the true and complete basis of calculation, which is found in the length of the arc on the earth with respect to a degree of the heavens, although he does not express this perfectly. Wherefore he himself assumes that it is fifty-six miles, and two thirds of a mile, and 27 ninetieths, and one six-hundred-and-thirtieth, or fifty-six miles and 2984 cubits and five sevenths of one cubit. Therefore if one considers the matter carefully, Alfraganus in his eighth chapter in this basis of computation, which is the length of the arc on the earth with respect to a degree in the heavens, as regards the diameter and semidiameter used by him, is found to omit 50 six-hundred-and-thirtieths of one mile, or, what is the same thing, 317 cubits, and a third of a cubit, 28 six-hundred-thirds of one cubit, since he merely states there that this arc of the earth is fifty-six miles and two thirds of one mile. But although he assumes the full basis of computation, he yet omits some fractions, owing to the tediousness of numbers. For it is his custom in his books frequently to omit fractions, and other authors do likewise. If, therefore, we wish to adapt the basis of computation to this length of diameter, namely, 6500, used by him, we

shall say that an arc of the earth corresponding to one degree in the heavens contains fifty-six miles, and two thirds of one mile, 27 ninetieths of a mile, and one six-hundred-and-thirtieth. And if we wish to compute by cubits the arc of the earth corresponding to one degree in the heavens will be fifty-six miles, and 2000 cubits, 984 cubits, and eight sixty-thirds of one cubit, which eight sixty-thirds are more than one-eighth of a cubit by one five-hundred-and-fourth of one cubit, as is easily shown. For eight sixty-thirds equal 64 five-hundred-fourths, and 63 five-hundred-fourths are an eighth of the whole: therefore, 64 five-hundred-fourths exceed an eighth by one five-hundred-fourth; and so eight sixty-thirds of one cubit exceed an eighth of it by one five-hundred-fourth. If we triple this diameter, 6500, and add a seventh of this, we shall have the circumference of the whole earth, and it will be exactly 20,428 miles, and 2285 cubits, and five sevenths of one cubit; or in other fractions, this number will be 20,428 miles, and four sevenths of one mile. According to this the whole surface of the earth will be 132,600,000 miles. According to this basis correctly computed a quarter of the earth will have 33,150,000 miles in its surface; an eighth will have 4,143,750 miles. For we are in need of these two quantities, as well as of the others mentioned before.

After looking into these matters we must consider the altitude of the heavenly bodies, and likewise their size and thickness. For Alfraganus says in the twenty-first chapter that Ptolemy and other scientists took the semidiameter as the length with which they measured distances from the center of the earth, and took the magnitude of the earth as the quantity with which they measured the magnitudes of the stars. This is quite clear from the demonstrations of Ptolemy in the fifth section of the Almagest. Therefore Alfraganus is of the opinion, from a comparison of the semidiameter of the earth with that of the starry sphere, that the distance of the starry sphere from the center of the earth is 20,110 times the semidiameter of the earth, 65,357,500 miles, which if doubled will give the diameter of the whole starry sphere as 130,715,000 miles. When this is multiplied into three and one seventh we shall have the circumference of a great circle in the starry sphere, namely, 410,818,571 miles, and three sevenths of a mile, that is, 1714 cubits, and two sevenths of a cubit. If we divide this number into 360 parts,

one part, which will be the length of one degree of the starry sphere, will have 1,141,162 miles and 251 three-hundred-sixtieths of a mile, that is, 2788 cubits, and eight ninths of one cubit. And if we reckon the diameter into rotundity, the surface of the whole starry sphere will be 53,700,149,508,265,000, namely, fifty-three thousand thousand thousand thousand thousands of miles, seven hundred thousand thousand thousand thousands of miles, one hundred forty-nine thousand thousand thousands of miles, five hundred eight thousand thousands of miles, two hundred sixty-five thousands of miles. Moreover, the semidiameter of the starry heaven is the longer distance of the sphere of Saturn, because they join without intermediate space. But its nearer distance to the earth is 46,816,250 miles, which is the longer distance of the sphere of Jupiter, whose nearer distance is 28,847,000 miles, which is the longer distance of the sphere of Mars, whose nearer distance is 3,965,000 miles, which is the longer distance of the sphere of the sun, whose nearer distance is 3,640,000, which is the longer distance of the sphere of Venus, whose nearer distance is 542,750, which is the longer distance of Mercury, whose nearer distance is 208,541 and two thirds of a mile, and this is 2666 cubits and two thirds of a cubit, and this is the longer distance of the moon, and this, as Alfraganus says, is sixty-four times and a sixth of one time equal to the half of the diameter of the earth, and the nearer distance of the moon is 109,037 and a half of a mile, that is, 2000 cubits, and this distance is thirty-three times and a half of a tenth, that is, one twentieth of one time equal to half of the diameter of the earth. The diameters of the separate spheres are obtained by doubling the semidiameter; the circumference of each is found by tripling the diameter with the addition of a seventh part, and the whole surface of each sphere is found by multiplying its diameter into its circumference, as was explained in the case of the earth and of the starry sphere. Any one can find these dimensions by computation, and for this reason I omit them to avoid prolixity. Since after substracting the nearer from the longer distance there remains the thickness of the sphere, it is therefore evident that the thickness of the sphere of the moon is 99,504 miles, and the thickness of the sphere of Mercury 334,209, and Venus 3,097,250, and of the sun 325,000, and of Mars 24,882,000, and of Jupiter 17,-

969,250, and of Saturn 18,541,250. These dimensions are derived from the principles of Alfraganus and of Ptolemy in the Almagest.

We must note that in all these altitudes distance is taken from the center of the earth. Hence, although scientists sometimes speak of these as being distances from the earth, they understand them, however, as reckoned from the center of the earth, because half of the earth makes no sensible difference. Since, then, the nearer distance of the sphere of the moon is 109,037 miles and half a mile, if half of the diameter of the earth is substracted, that is 3250, from the number of whole miles stated above, omitting the half mile, the remainder of the distance of the sphere of the moon from the earth will be 105,787. Now let twenty miles be taken as a day's march. Then if the moon's distance is divided by twenty the number of day's marches is found to be 5289 with seven miles remainder. If these day's marches are divided by the 365 days of one year, the result will be fourteen years, with a remainder of 179 day's marches, which if divided by thirty, the number of days in a full month, the result is seven full months with a remainder of one incomplete month, that is, a month of twenty-nine days. It is evident then that by taking twenty miles as a day's march a man could pass through the space to the sphere of the moon in fourteen years and five full months and one incomplete month, and there would still remain seven miles and the half-mile which was omitted at the beginning of the calculation.

Concerning the ninth and the tenth heaven nothing can be known by means of instruments belonging to the senses in the matter of their altitude, thickness, and size; also concerning the thickness of the eighth heaven, as we are able to do in regard to the other heavens, since all these matters are hidden from our sense, and therefore in regard to them certification of their magnitudes, altitudes, and thicknesses is lacking. By means of the nearer distance of the moon is ascertained the longer distance of the sphere of fire, but the longer distance of the air is not known. For philosophers have neglected this because it is not a matter of notable utility. Yet they have verified the distance to the position of the clouds, since it is demonstrated in the book on Twilights that their altitude is fifty-one miles and two thirds. Pliny, however, in the second book of

Natural History, says that the clouds have an elevation of four hundred and nine hundred stadia according to the different statements of philosophers. Therefore at the least the air extends so far and more; although Albumazar and certain others estimate that vapors are not higher than two miles and a tenth and a third of a mile. Ptolemy, moreover, in his book on the Arrangement of the Sphere says the greatest elevation of vapors is ten stadia, and Martianus in his Astronomy agrees. For they assume that the highest mountain is ten stadia high, as Olympus, on whose summit is found neither wind nor vapor, which fact men prove by experience. But since Aristotle in his book on Meteorologics maintains that vapors reach to the boundary of air and fire, therefore we must accept the opinion at least of the book on Twilights, and other views must be explained by the difference in quantity between the stadium and the mile. For sometimes we find that the stadium is an eighth part of a mile, and at other times is far more, and likewise there is great diversity regarding the length of the mile; for it is known that the mountains of Italy and other ranges, like the Caucasus, on whose summit the rays of the sun are apparent up to a third part of the night, have an altitude of more than eight times 125 feet, and therefore are more than eight stadia high, according to which the stadium is said to be 125 feet. Elsewhere I found in an exposition of the book Ormesta Mundi that a stadium contains two Gallic miles and two parts of one Gallic mile, and thus one stadium contains five miles and a third of a mile. Hence through differences of this kind the difficulties mentioned above are solved. The maximum height of mountains is with greater certainty considered to be eight miles, as is shown in the book on Twilights, and therefore in Ptolemy's book there may be falsity in translation or in writing, since the greatest height is placed at eight stadia.

After we have the altitudes of the heavens, it is evident that we have the heights of the stars according to the views of Ptolemy and of all mathematicians. For the nearer distance of the moon is the distance of its sphere, and the longer distance likewise is an altitude, and so of the others. But concerning the magnitudes and thicknesses of the stars our knowledge is not gained in this way. He, therefore, who could find their diameters could easily find their circumferences and their total

surface by the method I touched upon above in regard to the spheres. Certain ancient writers, as Martianus in his Astronomy, have striven to find the diameter of the sun and of the moon by the flow of water through an aperture in a vessel while the star is rising and while the whole sphere of the heavens revolves; and thus by means of those two quantities of water they found by how great an arc the diameter of the mass of the star is subtended.

Now these were water instruments like certain clocks, which are now made. For experimenters take a caldron with one orifice in the bottom, and fill it with water, and regulate it in such a way that at the exit of the first drop of water through the orifice the sun begins to rise, and at sunset they reckon the amount of water that has escaped, which they divide into twelve parts according to the number of the twelve hours, and therefore the flow of each part through the orifice mentioned marks a revolution of fifteen degrees, which makes one hour of the day. Therefore those wishing in this way to learn the size of the sun or moon allow the first drop of the diurnal water to escape when the first part of the sun rises, and when the last part has risen close the orifice. Therefore the ratio of the diameter of the sun, or of the arc of the heavens corresponding to this chord, to the total arc of the day is the same as the ratio of the water now escaped to the whole diurnal water. Others, however, by means of the astrolabe or the quadrant have reckoned how much the rule is moved while the extremities of the sun and moon are under observation, and then reckon that the ratio of the star to the circumference of the heavens is the same as that of the arc measured on the instrument to its whole circumference. But these methods do not possess sufficient certainty. For this reason Averroës says at the end of the second book of the Heavens and the World that the size of the diameters of stars is investigated by means of an instrument, which is mentioned, with two rules. For the former instrument determines the angle which the diameter of the star passes through, and the latter instrument consists of two rules extended in the manner of a pair of compasses for the space of four cubits, and at their ends are perforated feathers, so that the two extremities of the sun or moon may be seen. For by means of the angle between the two rules, when it is known, the diameter of the star is

known, since it is the base of that angle. This instrument was discovered by Abrachis, as Ptolemy maintains in the fifth section of the Almagest in the fourteenth chapter. Ptolemy, however, rejected the first methods on account of their insufficiency, and found this method of Abrachis had a defect. For according to this instrument of Abrachis he estimated the diameter of the moon at every distance to be equal according to aspect to the diameter of the sun because of the equality of the angles. But Ptolemy reckoned that the diameter of the moon is not equal according to aspect to the diameter of the sun except when the moon is at its greatest distance. This happens when the moon is at the aux of the epicycle, and the epicycle at the aux of the eccentric circle, and this again is when it is full. For at that time the diameters of the sun and moon are subtended according to aspect by equal angles. But when the moon is at any other distance this is not the case, and therefore the size of the angle is not determined when the moon is in any position whatever. The reason for this is found in the fact that the table is raised from the rule and the eye is above the surface of the rule, and for this reason the eye is not directed straight to the hole in the table but somewhat obliquely, and in that case what is between the two holes should be perceived, and what is between the rules is actually perceived; for this reason is there doubt regarding the size of the angle. On this account Ptolemy wished to determine the magnitudes of angles by lunar eclipses, in which he makes clear his point. Therefore by means of the instrument and by eclipses the magnitude of the angle is determined which the diameter of the moon subtends when it is at its greatest distance and is full. Therefore by means of the magnitude of the angle is determined the diameter of the moon, and by tripling its diameter with the addition of a seventh part the size of the moon's circumference is determined, and by multiplying the diameter by the circumference the total surface of the moon is determined and its whole size.

Since half of the diameter of the earth is the basis of this calculation, as used by Ptolemy in the fifteenth chapter of the section mentioned before, therefore we perceive the size of the diameter of the moon by its comparison with the diameter of the earth, and the size of the moon by comparison with the size of the earth. Therefore Ptolemy, in the sixteenth chapter, con-

cludes by means of his demonstration and drawing that according to a scale in which the diameter of the moon is one part, the diameter of the earth will be three parts and two fifths approximately. The diameter of the earth therefore will be three times the diameter of the moon and two fifths of it in length. Therefore if from the diameter of the earth, which is 6500 miles, we take the diameter of the moon, by computation the diameter of the moon will be exactly 1911 miles, and three quarters of one mile, and one seventeenth of one quarter; and if we triple the diameter with the addition of a seventh part we shall have its circumference, which will be 6006 miles, and six seventeenths of a quarter part of one mile: and by multiplying the diameter into the circumference we shall have the whole size of the moon, which will be 45,927,882 miles, and this will be about one of the thirty-nine parts of the whole earth, as Ptolemy shows. For according to the measurement by which the size of the moon is one part, will the size of the earth be about thirty-nine and a fourth times as large; since when the size of the diameter of the moon was taken as one part, the size of the diameter of the earth was three parts and two fifths. If, therefore, those quantities are multiplied into themselves cubically and as in solids, it is evident that one multiplied into itself cubically is only one, but three and two fifths multiplied into itself cubically make approximately thirty-nine and a quarter. Wherefore the size of the earth will be approximately thirty-nine and a quarter times as large as that of the moon. This is evident, because the quantity before mentioned respecting the size of the earth was found above as approximately thirty-nine and a fourth times as great as that of the moon, as is clear to one giving the matter consideration.

Moreover, the size of the diameter of the sun and of the sun itself depend, according to Ptolemy, on two things, namely, on the size of the diameter of the moon and on that of the semidiameter of the earth. For he finds the distance of the sun from the earth by means of the distance of the moon already known, and by the angles which the diameters of the moon and of the sun subtend in aspect when the moon is at its maximum distance at the time of full moon. For then the moon seems to cover completely the sun and no more, and for this reason the sun is then said to subtend in aspect the same angle as the moon sub-

tends. Nor does he take into consideration a different distance of the sun, because there is no difference in aspect, owing to the remaining distance, whether the sun is at its nearer or longer distance. He finds by these calculations that according to the scale by which the diameter of the moon is one part, and the diameter of the earth is approximately three and two fifths parts the diameter of the sun will be eighteen parts and four fifths of one part. The diameter of the sun will then be eighteen times the diameter of the moon, and four fifths of it; and the diameter of the sun will be approximately five and a half times the diameter of the earth. If, therefore, by means of the known diameter of the earth, which is 6500, we find the diameter of the sun, it will be 35,941 miles, and 12 seventeenths of one fourth. If this number is tripled with the addition of a seventh part, the size of the circumference of the sun will be 119,803 miles and one third and 12 seventeenths of one quarter. If we multiply the diameter into the circumference the total surface of the sun is 292,783,785,375 miles. If the number representing the diameter of the sun taken with respect to the diameter of the moon be multiplied into itself cubically, this cube will be approximately six thousand six hundred and forty-four and one half times as large; and therefore according to the scale by which the size of the moon is one part, the sun's magnitude with respect to the moon will be approximately six thousand six hundred and forty-four and one half times as great. But if the diameter of the sun compared with the diameter of the earth be multiplied into itself cubically, the cube will be about one hundred and seventy times as great. Therefore the sun is about one hundred and seventy times as large as the earth. This statement of his accords pretty nearly with the explanation of Thebit in his book entitled, Concerning those matters in need of expounding before the Almagest is read. But there is not an exact accord. For he says that the sun is equal to the earth one hundred and sixty-six times. Alfraganus in the twenty-second chapter of his book adds to the quantity mentioned by Thebit a fourth and an eighth of the earth, which fractions I previously determined to make certain of this passage. The sun is therefore one hundred and sixty times with the additions of a fourth and an eighth of the earth larger than the earth. This is the exact size of the sun according to the views of authors.

Ptolemy, however, determined only the size of the sun and of the moon. But Alfraganus says in the twenty-second chapter that the method is similar in the case of other stars to that which Ptolemy employs in these two. For in accordance with his discovery that the diameter of the moon, when it is at its maximum distance and is full, is equal in aspect to the diameter of the sun, so likewise when other planets are at the mid-point of their distances, their diameters have a fixed ratio to the diameter of the sun. For the diameter of Mercury in aspect* is one fifteenth part of the diameter of the sun, and of Venus it is one tenth part of the diameter of the sun, of Mars it is the one twentieth, of Jupiter the one twelfth, of Saturn the one eighteenth part of the diameter of the sun; since the diameter of Mercury is one twenty-eighth part of the diameter of the earth, and the diameter of Venus is a third part of the diameter of the earth and the third of a part, and the diameter of Mars is one and one sixth times that of the earth, and the diameter of Jupiter is four and one half times and one sixteenth of one time as large as the diameter of the earth, and the diameter of Saturn is four and one half times as large as the diameter of the earth, which is 29,250 miles. From these facts it follows that the size of Mercury is one part of the twenty-two parts of the earth, and Venus is one thirty-ninth part of the earth according to Alfraganus, but according to Thebit in the book mentioned it is one part of the thirty-two parts of the earth, and Mars is one and one half times and the half of an eighth of one time as large as the earth, and Jupiter is ninety-four and Saturn ninety-one times as large as the earth. If any one wishes to find by means of the diameter of the earth the size of the diameter of any one of the planets in miles, and by means of the size of the diameter desires to find the circumference and by means of both to find the total surface in miles it is easy for him to do so in the ways mentioned above.

Moreover, concerning the 1022 fixed stars Alfraganus gives the same method. For so many of these are known to scientists, which extend from the north to the remotest point which was visible to them in the third climate. For by instruments they are able to determine their sizes. But of these 1022 there are

* "In aspect" is used for the apparent diameter of the planets in terms of the sun's apparent diameter. See Bridges' note on p. 235, Vol. I.

six groups and differences of magnitudes, according to the teaching of Ptolemy in the eighth chapter of the Almagest, and of Thebit in the book mentioned, and of other scientists. There are, then, six magnitudes, and the first is greater than the others, and so consequently is its order of position. In the first magnitude, then, are fifteen fixed stars, as the Dog Star and the falling Vulture, and the Heart of the Lion and the like, the diameter of each of which is in aspect one twentieth part of the diameter of the sun, and the diameter of each of them is equal to four and one half times the diameter of the earth. Therefore each of these is one hundred and seven times the size of the earth, according to Alfraganus. From the measurement of these stars the size of the others is determined. There are, then, in the second magnitude forty-five stars, for example, six stars of the Greater Bear and two stars of the Lesser Bear, and each one of these is equal to ninety times the earth. In the third magnitude there are 208, for example, some stars of the Lesser Bear, according to Ptolemy, and many others, and each of these is equal to seventy-two times the earth. In the fourth magnitude there are 474, for example, four stars of the Lesser Bear and many others, and each one of these is equal to fifty-four times the earth. In the fifth magnitude are 217, each of which is equal to thirty-six times the earth. In the sixth magnitude there are sixty-two, each of which is eighteen times larger than the whole earth. Then there are other stars in infinite number, the size of which cannot be ascertained by instruments, and yet they are known by sight, and therefore have sensible size with respect to the heavens, like the part with respect to the whole. But the earth does not possess any sensible size with respect to the heavens, as Ptolemy proves in the beginning of the Almagest, and this is a certain fact, since the earth has the same relation to the universe as the center to the circumference of the circle. Wherefore each of those stars known to sight is larger than the whole earth, and Alfraganus states this in the fourth chapter. From all these facts, then, that have been mentioned in regard to the magnitudes of the heavenly bodies it is evident that greater than all, with the exception of all spheres other than that of the earth, is the sun: then in the second place are stars of the first magnitude; in the third place, Jupiter; fourth, Saturn; fifth, all the remaining fixed stars according to their

grades and orders; sixth, Mars; seventh, fixed stars known to sight; eighth, the earth; ninth, Venus; tenth, the moon; eleventh, Mercury.

According to the judgment of the sacred writers matters pertaining to music are necessary to theology in many ways. For although it is not necessary for an understanding of Scripture that the theologian should have a practical knowledge of singing and of instruments and of other musical things, yet he should know the theory of them, in order to grasp the natures and properties of these things and of the writings on this subject in accordance with their teachings of music theoretical and practical. For Scripture is full of musical terms like rejoice, shout for joy, sing, play upon the cithara, cymbals, and the like of different kinds. Moreover, Scripture contains in it many kinds of songs both in the New and in the Old Testaments. Likewise many kinds of meters are contained in the sacred Hebrew text, of which the sacred writers in their expositions take note in many ways. But it belongs to music to give the reasons and theories of these, although the grammarian teaches the practical rules regarding them.

Moreover, the whole pronunciation of Scripture consists in accents, longs, shorts, colons, commas, and periods; and all these belong causally to music, because of all these matters the musician states the reason, but the grammarian merely the fact. For so the authors of philosophy decide, also Augustine so decides regarding them in dealing with music. For one part of music deals with what is audible, the other with what is visible, as authorities decide. That which deals with the audible has two divisions, of which one concerns the human voice, the other instruments. That which concerns the human voice is fourfold. For one part concerns melody, as in singing; the second concerns meters, and considers the nature and properties of all songs, meters, and feet; the third concerns rhythm, and considers every variety of relations in rhythms; the fourth concerns prose and considers accents and other aforesaid things in prose discourse. For accent is a kind of singing; whence it is called accent from *accino, accinis* [I sing, thou singest], because every syllable has its own proper sound either raised, lowered, or composite, and all syllables of one word are adapted or sung to one syllable on which rests the principal

sound. Thus length and shortness and all other things required in correct pronunciation are reduced to music, and concerning them the authorities on music decide, as is evident in Censorinus on accents and in Martianus and in many others. These matters are explained by Isidore and Cassiodorus in their statements on music. Augustine reduces meters and feet and matters of this kind to the subject of music. The perfect theologian therefore should have the mastery of all these things, because in the literal and spiritual sense their natures and properties are required, as the sacred writers decide in many ways. Now music on instruments determines the structure of the instruments and their use. Therefore since Scripture is full of instruments of this kind, the perfect theologian ought to know, at least in general, the structures of instruments, and to know how use has to be made of them on account of their numberless mystical meanings besides their literal ones. Music, moreover, consisting in what is visible, is necessary; and that it is such is evident from the book on the Origin of the Sciences. For whatever can be conformed to sound in similar movements and in corresponding formations, so that our delight may be made complete not only by hearing, but by seeing, belongs to music. Therefore dances and all bendings of bodies are reduced to gesture, which is a branch of music, since these are conformed to sound in similar movements and corresponding formations, as the author of the aforesaid book maintains. Therefore Aristotle says in the seventh book of the Metaphysics that the art of dancing is not complete without another art, that is, without another kind of music to which the art of dancing is conformed. Dancings, therefore, and other flexions of the body, which Miriam, sister of Moses, Deborah, and other women singers used as well as David and other male singers, of which Scripture treats in many ways, ought to be known to theologians, in order that they may know how to express all their properties, so that they may give utterance to all the spiritual senses of an angelic devotion.

Although it is now sufficiently apparent that these sciences must be necessary in respect to theology and philosophy, yet their far greater utility must be considered by means of the other important ways which pertain to wisdom not only absolutely, but as it ought to direct the Church of God, and care for

the other three matters touched upon several times, as will be explained below.

Now that we have shown how mathematics is necessary to wisdom, both sacred and human, we are still under the necessity of proving what has preceded, in order that certain sophistries to the contrary may be exploded and certain statements of the sacred writers may be expounded, so that all doubt may be removed regarding the utility of mathematics. Mathematics is most subject to attack owing to the judgments of astronomy. Since, then, the contention of many ignorant of the potency of philosophy and its very great usefulness to theology, and condemning both relatively and absolutely the views of mathematicians, impedes the pursuit of knowledge and does it very serious harm in this respect; I therefore wish at the present to verify their purpose, and to remove the infamy attaching to true mathematics. Theologians then have found many statements scattered abroad by the sacred writers against mathematicians, and some of these men, owing to their ignorance of the true mathematics and of the false, do not know how to distinguish the true from the false, and therefore condemn the true with the false as though by authority of the sacred writers. For the word for the true mathematics is said by many authors to be written with an aspirated *t,* and to be derived from this word *mathesis* with short middle syllable, meaning knowledge, and it is certainly derived from the Greek; because the verb *matheo* is the same as *disco* [learn], and *mathetes* is the same as *discipulus* [learner], and *mathesis* is the same as *disciplina* [instruction]. Whence *mathematica* [mathematics] is instructional and theoretical knowledge, as Cassiodorus said above. But the word for false mathematics is said by the same authorities to be written without an aspirate and to be derived from *mathesi* with long middle syllable, meaning divination, or with greater certainty, from *mantos* or from *mantia,* which are the same as *divinatio* [divination], as Jerome states in the original, Isaiah, chapter IX. But whatever it may be as regards its writing and derivation, false mathematics is the art of magic. For there are reckoned to be five kinds of magic art, namely, prescience, mathematics, charms, illusions, fortune telling.

Mathematics, then, is the second division of magic. This subject usurps a consideration of the heavenly bodies which is

marred by characters, incantations, conjurations, superstitious sacrifices, and various frauds. It maintains that all things by virtue of the constellations happen of necessity, that nothing may happen in one of two ways, that nothing happens by chance nor by fortune, nothing by design, yet from the excellence of its essence and in aid of the constellations it has made a more efficacious arrangement of the forms of the characters appropriate to each of the constellations and of the other things aforesaid. These matters are expressly stated in books on magic, whence this science claims that all these things happen of necessity by means of the heavens, and presumes by this necessity to judge infallibly concerning all future events. But this form of mathematics has been condemned not only by the sacred writers, but by the philosophers, as Isidore states in his tractate on Astrology, asserting that one branch of astronomy is full of superstition, namely, that which is magic, and is called prophetic mathematics. Whence Aristotle and Plato, on the testimony of Isidore, condemned it: and Pliny, attacking it frequently in different places in his Natural History because of the errors which this fantasy has written in matters relating to nature and to medicine, at length in utter abhorrence of it discloses in his thirtieth book its origin, and shows clearly how it has defiled the whole world. Tullius also in his book on Divination, more particularly treating of its evil, shows that it destroyed divine worship, did violence to the republic, and infected medicine and natural philosophy, and subverted all the good arts. Ptolemy also and Aristotle, Avicenna, Messehalac, Hali, and Albumazar, who in comparison with others have spoken with greater authority in regard to these matters, do not maintain that there is an absolute necessity in things below due to the influence of the heavens, because free will is not subject to the things of nature, nor do they think that the decision must be infallible, nay, they do not even place any necessity on free will, since they do not ascribe it to the things of nature, as will be evident. Therefore, philosophers universally condemn the madness of those false mathematicians.

Not only are they condemned on the principal count, namely, because of the error they hold regarding the heavenly bodies, but also because those mathematicians summon to their aid demons of celestial natures by means of conjurations and sacri-

fices, which is wholly wicked, and, moreover, defile their studies in regard to the heavenly bodies by circles and figures and very silly characters and very foolish incantations, and irrational speeches in which they trust. Moreover, they have recourse to fraud in their acts, perpetrated by means of collusion, darkness, fraudulent instruments, sleight of hand, in which they know there is deception, and they do many things to be wondered at by the foolish by these means, in which matters the influence of the heavens is not operative, and therefore contradicting themselves, they know in their hearts that their statements to others attributing influence to the heavens have no truth. Likewise although elsewhere in certain conjurations and sacrifices and incantations and various figures do they trust as though coöperating with the constellation according to their judgment, yet frequently they arrange these things in a fraudulent manner according to the kinds of fraud mentioned above, and in the presence of those believing in them they ascribe very many things to the constellation in respect to which it has no power. This fact does not escape them. Therefore on account of these follies of false mathematics philosophers have condemned it, and the sacred writers and catholic men perceiving these facts together with the philosophers have rejected it.

But the special reason of the sacred writers for their position was the fact that such mathematicians hindered in the beginning the entrance of the faith into this world, because not only imbued with this fantasy did they err in the faith and fashion their morals in accordance with the heavenly bodies, under the impression that they were made of necessity by the heavenly bodies and by the other agencies mentioned either irascible or mild-tempered, chaste or wanton, and so also concerning other matters; but they also ascribed the miracles, proving the faith of Christ, to that kind of mathematics, saying that the Christians are mathematicians and magi seducing the people. For just as by means of this demoniacal cunning they were able to do many things in the presence of an ignorant people by which they chained them to their errors and ruled over them, so did they bring the charge against the apostles and martyrs and other preachers of the faith that they did not do real miracles by the power of God, but by means of the magic art which they themselves employed.

But true mathematicians, whom in this field we call astronomers or astrologers, because they are so called indifferently by Ptolemy and Avicenna and many others, are not confuted in regard to sacrifices, conjurations, incantations, and characters, as even the rank and file of students are aware, but are censured only in regard to infallibility of judgment and the necessary happening of events. Now we cannot detect their view unless we extract their own statements from their books, so that thus from their own words we may condemn them if in error, or snatch them from the teeth of the ignorant throng and set them free if they are guiltless. Since, then, the most serious charge against them is the error in regard to judgment as though they wished in an infallible way to contend with divine certitude, as they are charged by people in general, let the nobler philosophers be cited, namely, Aristotle, Avicenna, Ptolemy, Hali his commentator, Messehalac, and Albumazar, on whom more than on others rest this burden. In general, then, in our examination of what is to be considered as the view of the philosophers in this matter we note that Ptolemy states in the beginning of the Centilogium, "The astronomer should not state a matter specifically but in general terms, as one who views something from a distance," and he adds, "The judgments that I give you are between the necessary and the impossible."

Hali says on this passage, "He made this statement, because this science does not exist except through demonstration and opinion since the subject to which the whole work of the stars pertains is convertible to the one and to the other." Wherefore in the fifty-ninth chapter of the Centilogium according to one translation he says, "When you have been asked about one that is absent, you should not decide the question of his death, until you remove that of his intoxication; nor should you settle the question of a wound, until you remove the possibility of blood letting; nor the question of a man's acquired wealth, until you remove the possibility that the money was merely entrusted to him; for in all these cases the judgment is the same." Hali also says, "He who gives judgments, judges by the forms which are near the truth, because the ability is not found in judgments to separate or distinguish between an unconscious person and one dead, nor between a wounded person and one who has submitted to blood letting, nor yet between the man to whom

money has been entrusted and him who has amassed it": and he adds an example, "When his father was hiding along with others from the emperor, an astrologer visiting him daily directed him to take a very large bronze vessel full of water and place above it a stool, and advised him to sit thereon the greater part of the day. He gave him this advice, in order that he might cause the astrologers of the emperor to err in regard to the state of those in hiding. For they said that he was in the middle of the sea owing to the similarity of the water in the vessel above which he had been seated. For they were unable to distinguish between the one and the other because of the likeness of the container and that contained. For he was contained on all sides by the water, and the concavity of the vessel indicated the concavity of the bed of the sea."

Likewise Ptolemy in his book on the Arrangement of the Sphere says, "The judgments of the astronomer concerning matters here below are not drawn from an artificial science, by which their boundaries are necessary ones, but from those things that are most general." Again he says, "Astronomers have made that statement not in an artificial way, not according to a fixed innate quality, but by means of a conjunction falling upon the thing more nearly related." And in a third passage he says that "it is clear that what they affirm is affirmed in the most general manner not in an artificial way and does not involve necessity." For this reason, therefore, error will often happen in these matters, as he states. Ptolemy also in the first chapter of the Quadripartitum says, "But the hidden profundity of this art so excellent and its practice so majestic and incomprehensible, that it cannot be wholly grasped by human genius, seem to be the result of its ineffable subtlety and of a certain divine quality as it were belonging to it." For it is far removed from human sense, and transcending corporeal nature it rises as it were far beyond man. And in his third chapter he says that "from the excessive profundity of this art error happens at times." Wherefore according to Ptolemy, to whom at the present time especially is ascribed the method of pronouncing judgments, it is clear that the astrologer cannot give full certitude in regard to his judgments, especially in particular judgments. This is clear not only from these, but from his other discourses, in which, although he hints at the possibility of

judging about many things with reasonable certitude, yet he unqualifiedly states that such great difficulty is inherent in the art, that it is easily apparent that he himself places the definite limit, that the astronomer ought not to boast of sufficient certitude in particular judgments. Whence in the first chapter of the Quadripartitum he says, "For although this thing is to such a degree difficult, that by no means can it be brought absolutely to a conclusion, yet it does not seem fitting that it should be given up, but rather have we deemed it proper to set forth those things that are not beyond our ability." And after a few statements he continues, "The prosecution of such an art is so difficult and laborious that without a daily practice wholly free from secular affairs and exempt from unprofitable cares no one can by any means aspire to it." And because for those free from other cares and filled with zeal there is an excellent prospect of becoming proficient in this science, he says in the second chapter, "By no means does it seem proper to me, if error happens elsewhere to banish the art wholly from us." Moreover, he cites an example, saying, "For if sailors, exercising too little caution in regard to the rocks in the sea, suffer shipwreck due to some error, they go aboard again when their ships are refitted with no loss of their former feeling of safety, alacrity of mind, hope, and confidence. In this manner also let us eagerly acquire, as far as the possibility of our human talent permits, this science of the stars, firm and certain and unchangeably constant in its truth, so that we may try to win for it the kindly interest both of students and of others, to the end that keeping in mind the dignity of the art itself, they may secure under its guidance a knowledge of the future; but let those matters prohibited by the art itself owing to their difficulty be abandoned." And in the third chapter he argues, "Although error happens here, we must regard the incongruity as passed over by negligence or blotted out by forgetfulness." After a few statements he adds, "But since it is most evident that this preconception of the future is not held with error, and that not all kinds of this art are involved in errors, it remains to disclose with greater care what is to be derived from this efficacious art, also in what ways innovations can be rejected. But if it has not the power to give particular judgments, it should not however escape showing all that has been placed within the range of possibility. If this

shall be found to be very small, we do not judge it of less profit that it is reduced to narrower limits." And he gives us an example, "For although physic is not the cause of every man's health, yet since it is of some men, we think that it is desirable because of its utility."

From these statements and from similar ones it is clear that it is not Ptolemy's thought that the astrologer should give in particular a fixed judgment and one sufficing in individual cases; but that his judgment should be a general one and a mean between what is necessary and what is impossible, and the astrologer is not able in all cases to give a final judgment. For this reason Avicenna, who completed the works of Ptolemy, as he states in the prologue of his book entitled Sufficiency, shows in the tenth book of the Metaphysics that the astrologer is not able to give certain assurance in all cases nor should he, owing to the instability of generated and corruptible matter, which does not in all cases obey the celestial force, as Messehalac states, giving as an example the magnet, because it exercises its power over iron only when it is adjusted at the necessary distance and under the other conditions requisite for attraction.

Moreover, they know that the divine rule can change all things according to its will, and for this reason they add always at the end of their decisions the qualification, "Thus shall it happen if God wills it." But they themselves know and testify that the rational soul is able to change greatly and impede the effects of the stars, as in the case of infirmities and pestilences of cold and heat, and famine, and in many other matters, as Ptolemy states and teaches in the Centilogium. Hali expounds him; and Isaac in his book on Fevers sets forth clearly this same principle; Aristotle, moreover, in his book of Secrets confirms and declares it. For when men see beforehand these evils, they are able to prepare remedies. Whence Isaac says, "Evil does not happen to a man unless he is restrained by ignorance of the celestial science," and he gives an example in the case of pestilences and infirmities and matters subject to the will, in which this science can give remedies, if it is thoroughly known. From these statements, then, it is clear that philosophers do not maintain that there is an inevitable happening of events in all cases due to celestial influences, nor is their judgment in-

fallible in particular instances, but in accordance with the possibility of this science; particularly so since they also add that another science, which is called experimental, gives a still more certain judgment than the ordinary astronomy. So teaches Ptolemy in his book on the Arrangement of the Sphere, and this matter is made clear in what follows.

Therefore, after a careful consideration of these statements and the like, it is clear that true mathematicians and astronomers or astrologers, who are philosophers, do not assert a necessity and an infallible judgment in matters contingent on the future. Therefore any persons attributing these erroneous views to these men are clearly proved guilty of ignorance of philosophy, and reprobate the truth of which they are ignorant. Whence their sin is twofold, namely, because they handle these matters of which they are ignorant, and nevertheless blaspheme against the truth. But those who so view things which are true that they reject what is false condemn mathematicians dealing in magic, who are not philosophers but contradict both philosophy and the faith, as I explained at the beginning. Therefore the sacred writers have spoken against them and not against true mathematicians. This is made clear by the opposition of the sacred writers. For they reprobate nothing except the principle that through the stars a necessity is placed on contingent things and particularly on morals and human acts, and that there is an infallible judgment in all cases. But mathematicians practicing magic alone maintain these doctrines, and true mathematicians make no such statements. Wherefore whatever Basil in the Hexaemeron and Ambrose in the Hexaemeron, and Augustine and Gregory in the homilies on the Epiphany and Augustine in his comments on the sixty-first and ninety-first Psalms and on John, and whatever he and other learned men say in many other places against mathematicians, is wholly directed against those who imagine that necessity is placed upon those things in which there is choice, and particularly in matters which proceed from free will, who alone are lying or fraudulent mathematicians, full of superstition, not philosophers, as is manifest. Therefore they err greatly who strive to defend their madness against true mathematicians on the authority of the sacred writers, and making a wrong use of the words of the sacred writers presume to condemn the truth.

Whence they strive to establish their views although false, which they form from an ignorance of mathematics true and false. Since, moreover, they can bring no reason to bear, because their statements against the true mathematicians are opposed to all reason and to the force of philosophy, they seize and purloin the authorities of the sacred writers which have nothing to do with the matter in hand, as is clear to the investigator.

We must bear in mind, moreover, that if we consider the words of the sacred writers we shall clearly discover that not only do they not reprobate true mathematicians, but approve in the matter of their knowledge of the future; since Augustine says in the second book on Christian Doctrine that mathematics has regular conjectures regarding the future, not rousing distrust and ominous, but direct and certain concerning the future as well as the present and the past. Cassiodorus agrees with him, as was said previously. He shows to Januarius in many ways how the future can be learned by means of the heavenly bodies. Basil in the Hexaemeron declares this likewise in many ways; from this source he declares there is a most certain judgment in some cases. Ambrose in the Hexaemeron agrees, and Isidore in his work on Astronomy. The sacred writers confirm their statement by the Gospel, "from the red sky in the evening or in the morning," and again "there shall be signs in the sun and in the moon," etc. Mathematics is not therefore infamous from the knowledge of the future which it gives in a trustworthy manner; although in the beginning the sacred writers made less use of it and commended it less because of the error of false mathematics, to which in name and in a certain consideration of the heavenly bodies respecting the future true mathematics is allied and in accord, as Augustine decides in his book on Christian Doctrine.

But after the falsity of mathematics dealing with magic was cleared away in the Church, the study of true mathematics was taken up by the Catholic doctors, and was continued until the advent of certain theologians, who were ignorant of the potency of philosophy and the fallacies of magic. For this reason they have condemned it in their lectures, preaching, and collations public and private, in the first place to the very great destruction of philosophy, and in the second to the injury of the dig-

nity of theology and to the detriment of the Church and of the whole commonwealth of the faithful and of the conversion of unbelievers, as we have previously shown in great part, and as we shall show later respecting the remainder; because where there is an ignorance of mathematics the whole potency of philosophy will be unknown. If the truth of philosophy is impaired, damage is inflicted on theology, whose function it is to use the power of philosophy, not only absolutely, but in ordering the Church, directing the commonwealth of believers, and aiding the conversion of predestined unbelievers and the reprobation of those foreknown. But not only do they err in this that they ignorantly condemn knowledge of the future secured by means of mathematics, but because for the sake of a part, which they abhor as a result of their own ignorance, they condemn the whole. For although in the parts of philosophy there are very many things that are useless and not so well discussed and some erroneous, yet nevertheless by no one is the whole of philosophy condemned, nor should it be nor can it be condemned. Wherefore since in all the other divisions of mathematics apart from that pertaining to judgment all advantages are offered in respect to theology, the Church, the conversion or reprobation of unbelievers, and in respect to philosophy as a whole, and nothing reprobated is found even in that part to which judgment is ascribed, and since many excellent things, besides the art of judging, respecting the properties of celestial things and the favorable influences of the stars and respecting other matters of this world are discussed, it is manifest that those are wholly in error who have ventured on account of one part which they falsely condemn to reprobate all the remainder, which possesses very great advantages and in no respect is subject to calumny. Again although the part relating to judgment concerning human affairs should be deserving of blame, yet the other part dealing with natural sciences and the heavenly bodies brings no calumny on the faith.

But in human affairs true mathematicians do not presume to certain knowledge, but they consider how the body is altered by the heavens, and when the body is changed the mind is aroused now to private actions and now to public ones, yet in all matters is the freedom of the will preserved. For although the rational soul is not compelled to its acts, yet it can be

strongly influenced and aroused, so that it gratuitously desires those things to which the celestial force inclines it, just as we see men, owing to association, advice, fear and love and the like, change greatly their intention, and gratuitously wish for those things which they previously did not wish for, although they are under no compulsion, like him who in the hope of safety casts into the sea his most precious wares. But we see that the species or forces of things below altering our senses, also the species of things visible and audible which feebly change the body, so strongly excite men to wish for those things for which they did not formerly care, that sometimes they do not take into account death, disgrace, or fear, provided they may satisfy their desires, like those who see and hear that their enemies are coming to meet them, and they rush along heedless of risk in order to revenge themselves on them. In the same way voluptuaries, when the chance is secured of indulging their desires respecting things seen and heard, like brute beasts are influenced against the judgment of reason, gratuitously choosing those things to which they are excited.

But to a far greater degree are the forces of the heavenly bodies and the strong species of the stars able to influence the body and its organs, and when these have been greatly altered the man will be strongly excited to actions for which he did not previously care, the freedom of his will remaining unaltered; since the forces of the heavens are stronger than those of the visible and audible things below and of many other objects of sense perception, and are able to alter substance, not merely accidents, and to corrupt and destroy all things here below; since in accordance with the sun's position on the oblique circle generation and corruption in things occur, as Aristotle says. Not only is this position of the sun considered absolutely, but in connection with the forces of the other planets and stars; and for this reason there is a great change in our bodies, due to celestial forces, and consequently the mind is strongly excited to its actions, although it is not under compulsion, and in accordance with this principle the judgment of the astronomer is given, and does not imply infallibility or necessity. The astronomer relies greatly on this, because he sees that men in their actions follow for the most part the temperament that they have, as, for example, the choleric man is easily moved to

anger, and is unable to restrain all the first promptings, and so in regard to other characteristics in respect to which men differ in their temperaments. Therefore in the case of the astronomer, where he sees that men follow their complexions, which spring from celestial influence, like all generation, it is not surprising if he extends this influence to the sphere of human actions.

But he sees clearly that the manners of those dwelling under different parallels of the heavens differ according to their position, as, for example, those dwelling toward the pole, as the Scythians, have different manners from those dwelling toward the south, as the Ethiopians; and those dwelling in the fourth climate have different manners from those just mentioned; nay, according to diversity of each climate and even of the parts of a climate do the manners of the inhabitants differ, as, for example, in the seventh climate we clearly see that the Picards, French, Normans, Flemings, and English differ in their manners, notwithstanding the fact that they are neighboring one to another. But this diversity does not have its origin in the men themselves due to a difference in their rational soul, but is due to the complexions of their bodies innate from the nature of the heavens, under the different parallels and stars of which they are situated, and in accordance with the diversity of their location with respect to the planets. Moreover, this diversity is not only in accordance with the latitude of the regions measured from the equinoctial circle toward the pole, but in accordance with longitude also, although the reasons are more occult. By experience we note that under the same parallel regions differ according to their greater distance from the west or east, and not only is this true of the regions themselves, but also of their parts. The chief cause of this difference cannot be found in the earth or in men, but is sought for in the heavens according to all scientists; whence, as has already been stated, on every point of the earth there is incident the vertex of a pyramid full of force from the whole heavens. These virtues are different in nature, and the pyramids likewise, because they have different bases owing to the differences in their horizons, since every point of the earth is the center of its own horizon. Therefore of necessity a great difference in all things arises from this cause, no matter how close they are, like twins in the same womb; and such is the case in all things, just as we see

that from two points very close to each other on the earth plants spring differing according to species. On this principle the astronomer rests the foundations of his judgment, and rightly so, because the complete diversity in things is thus discovered to be due to the heavens. Wherefore the skillful astronomer is able not only in the things of nature, but also in human affairs to consider many things regarding the present and the future and the past, and therefore at least as regards kingdoms and states is he able to judge by means of the heavenly bodies and of the secondary members of the same, which are renewed by special forces of the heavens, such as comets and the like, because it is an easier judgment in regard to a community than in regard to an individual. For a judgment respecting a community is a general one, and the astronomer is well equipped to give general judgments. Because the whole province surrounding any famous city is affected by its manners and customs due to the fact that the city serves as a refuge and a central point for transacting the affairs of life, and to the additional fact that cities have power over the neighboring districts (and it is true also of a more powerful kingdom in respect to the surrounding kingdoms), both on account of communication and violence; the prudent astrologer is able to consider many things in this particular advantageously in regard to customs and laws and parties and wars and peace and the like, which pertain to the commonwealth of states, provinces, and kingdoms, although he encounters greater difficulty in judging of the acts of individuals.

If he wishes to consider carefully and without error the hours of conception and nativity of individuals, in order that the domination of the celestial force may be known at those hours, and if he carefully considers when the heavenly bodies will reach these arrangements in accordance with the separate parts of the age of each, he is able to give a satisfactory judgment in regard to all things in nature, such as infirmities, health, and the like, at what time they must happen and how they are limited, as authorities not only in astronomy, but in medicine, like Hippocrates, Galen, Hali, Isaac, and all other authorities, decide. But few physicians of this time know astronomy, and therefore many of them neither understand their own authors nor can they understand them, and for this reason

they neglect the better part of medicine. But concerning them a long and useful discussion is possible when the opportunity comes. Since, moreover, in accordance with the complexions, weaknesses, and health vary the wishes of men and their longings and views, although they are not compelled but strongly influenced, as is manifest, the prudent astronomer is able to give a wise judgment regarding the moral actions of an individual, in all cases, however, with a preservation of the freedom of the will, and he will be able in many instances to form a sure judgment in accordance with the possibility of the subject which he handles. For since this is contingent and not necessary, he cannot say that of necessity these or those things will happen, yet he can say in many cases they will happen, and that truth exists concerning the future although not of necessity. For it is one thing to be true, and another to be rendered true of necessity. This is the judgment resting between what is necessary and what is impossible. In cases where he cannot form a judgment of this kind, he will easily form a general judgment, or one lying between the universal and the particular; yet by means of a general judgment and in accordance with what is possible regarding a public personage, as a prince and a prince's counselor in a state or district, he is able more frequently to form a particular judgment concerning the deeds of the commonwealth; because, as has been said, it is easier to judge concerning a community than concerning an individual, and in accordance with the judgment of the prince are states and kingdoms ruled; for that which pleases the prince has the force of law.

Therefore the astronomer is influential respecting the affairs of famous cities, provinces, and kingdoms, provided he be well informed about the domination of the heavens at the conception and nativity of the prince, also as regards the fact that complexion is altered by this means, and that morals are shaped in accordance with the quality of the complexion. Then let him note when the constellation comes which stimulates and strengthens the complexion, so that the mind is stimulated and aroused to similar actions; and likewise let him note when the complexion is altered into the opposite by arrangement of the heavens, so that the mind of the prince is aroused to opposite courses of action. For in accordance with variations of this

kind in the constellations and complexions and wishes of princes and prelates innovations in habits and change in laws and customs arise in a people on higher authority. Moreover, there easily arise at times discords and dissensions, which are followed by wars, or at other times, due to the excellence and utility of the laws, concord springs up between citizens and others, and peace is made. Therefore the skillful astronomer is able easily to give judgment regarding the common affairs of this kind in states and districts, because he has the means of proceeding not only by ways proper to them, but by means of the natures of personages in authority. So likewise are they able to judge by the qualities of those who assist princes and prelates, and on whose counsels they rely, because wicked princes are influenced for the good of the state by good counselors, and good princes are perverted by evil counselors. If, therefore, from the constellation of the nativity and conception the complexion of any prince, or of another on whom he relies, is found disposed to perversity of morals and to discords and wars, and if the astronomer at the same time with this sees that men are influenced in this way in the formation of habits and are more strongly aroused when a like constellation happens, he is able to give a rational judgment regarding the woes of the state and kingdom over which they rule, when the arrangement of the heavens and of those things which are renewed by celestial forces, like comets and the like, happen conformably. The best judgments can be made in accordance with the opposite natures of princes and of those whom they trust in all matters, when likewise there is found a celestial arrangement in conformity. Since such personages in one kingdom are few, and are public characters and known to all, whose manners are revealed to the whole kingdom, the astronomer is well able to make certain concerning them, and to give a useful judgment regarding public matters by means of the qualities of such personages. These, then, are the statements I have desired to make in order to remove the infamy resting on mathematics in judgments of this kind, from which it is clear to every man of wisdom that true mathematics is not to be blamed in this matter, but to be embraced warmly and loved owing to the glorious utilities which can come out of the judgments of true mathematics, which in no way is contradictory to the truth.

Since the potency of mathematics has been shown in respect to the sciences of philosophy and to the things of this world and to theology, and so in respect to all knowledge, just as knowledge itself is considered absolutely in reference to itself, I now wish to show that same thing with reference to the influence of this knowledge on the Church of God, the commonwealth of the faithful and the conversion of unbelievers and the repression of those who cannot be converted. Since in many ways which cannot now be enumerated it is necessary to the Church, I wish now to set forth three cases that are of infinite wonder and ineffable utility. The first consists in the certification of the faith which the Church holds. For we can have great consolation in our faith, since the philosophers who have been led by the exercise of their reason alone agree with us, and strengthen the body or profession of the Christian faith and agree with us in the stability of this body; not because we seek reason before faith but after it, so that rendered certain by a double confirmation we may praise God for our salvation which we possess without doubt. By this means offered by mathematics not only are we made certain respecting our profession, but we are fortified in advance against the sect of Antichrist, about which at the same time with the Church of Christ mathematics is concerned. A very excellent examination of this kind is made by considering all the principal sects from the beginning of the world, which are six in number, nor can there be more, namely, Jews, Chaldeans, Egyptians, Agarenians or Saracens, who descended from Agar and Ishmael, the Church of Christ, and the sect of Antichrist. Nor is it strange if the philosophers have spoken regarding these, since they were after the patriarchs and prophets and were instructed by their sons and books, as we have previously shown.

I shall then at the present time state to the best of my ability the opinions of the mathematicians in which authorities agree. They say, then, that Jupiter and Venus are benevolent and fortunate planets, Saturn and Mars malevolent and unfortunate ones. Mercury, they say, is in a middle position, because he is good with the good, and evil with the evil, since he is of a changeable nature. Of the benevolent and fortunate planets they say that Jupiter is the better and that greater good fortune is owed to him, and less to Venus. Therefore since there

are two lives, the present and the future, and the future is more important than the present one, just as that which is eternal is more important than that which is temporal, they say that Venus has significance regarding the fortunes of this life, as far as pertains to games, pleasures, joy, and the like, and Jupiter has respect to the blessings of the other life, which are greater. He has signification in regard to wisdom and intellect, interpretation of dreams, divine worship, faith and doctrine of the law, veneration and fear of God, fitness of morals, and many such things, as astronomers state.

Moreover, they divide the whole heavens into twelve parts, called houses, which are separated by the meridian circle and the horizon, and by four other circles intersecting one another at their points of meeting, so that the first house begins at the horizon and is formed beneath it, then there succeed it the second and the third up to the angle of the earth, which is the point in the heavens beneath the earth opposite to the point of the meridian above the earth. From that point there are three other houses up to the line of the west. Then above the horizon begins the seventh house and the eighth follows and the ninth up to the point of the meridian. Then come the tenth, eleventh, and twelfth to the east. The first house they assign to Saturn, the second to Jupiter, and so on according to the order of the planets, so that the eighth again is assigned to Saturn, and the ninth to Jupiter. All have agreed in considering the ninth house as that belonging to religion and faith. Ptolemy, Albumazar, Altavicus, Messehalac, and all others have assigned to these houses their properties, because the first is the house of life, the second the house of substance, and so on with the others, according to their properties and natural dispositions. Whence the ninth house, as they say, is that of peregrinations and journeys of faith and deity and religion, and the house of the worship of God, of wisdom, of books, letters, and of the accounts of ambassadors and reports and dreams. Therefore rightly, as they say, is the house assigned to Jupiter, who is significant with regard to the blessings of the other life, because for those blessings there are needed faith and religion and the worship of God and the study of wisdom, and a multitude of books and of letters, as is evident from the sacred law; and a large number of ambassadors, such as prophets and apostles and

preachers, making suitable reports regarding the noble state of that life and having frequent revelations in dreams and ecstasies and visions concerning this life.

They say, then, that the planets are in conjunction and embrace one another in turn, and this happens when they are in the same sign and especially when they are in the same degree and in the sixteenth minute of that degree or below it. Therefore the philosophers maintain that Jupiter, from his conjunction with other planets, has signification regarding the division of religions and faith. Since there are six planets with which he can be united and in conjunction, they therefore assert that there must be six principal sects in the world. Whence the skillful authorities aforesaid and others say if Jupiter is in conjunction with Saturn, he signifies the sacred books and of the sects that of the Jews, because it is more ancient than the others and prior to them, just as Saturn is the father of the planets and more remote and prior in the egress of the planets and in their order in existence. All faiths acknowledge it, and it acknowledges no other, just as all the planets are in conjunction with Saturn and he with no one of them because of the slowness of his motion. Because when a planet is before him to the east, Saturn never overtakes it, but the other planet is so far superior, that at some time or other it overtakes Saturn and is in conjunction with him. All sects, in fact, trace themselves back to the sect of the Jews, because this was the first and is the root of the others, from which all have taken evidence of some kind and have found a basis for their sect: whence philosophy has received much evidence and many ways of establishing its cult, as we have previously shown. If, however, Jupiter is in conjunction with Mars, they say that he has significance with regard to the Chaldean law, which teaches the worship of fire, of which nature is Mars in natural potency and effect. If he is in conjunction with the sun, his reference is to the Egyptian law, which maintains the worship of the host of heaven, of which the sun is chief. If he is in conjunction with Venus, his reference is said to be to the law of the Saracens, which is wholly voluptuous and lascivious. Although Mahomet reduced this law to writing, yet through long ages was it regarded by its votaries as the rule of life. Whence the book De vitae sua mutatione, attributed to Ovid the poet, speaking of the lascivious sect, which

the book stated was the law of the people in the poet's time, says,

"In which anything pleasing is considered lawful,
Although a written law regarding it is not yet found."

This law more than six hundred years later Mahomet reduced to writing in a book called the Alcoran. For Ovid was before Christ and lived in his times, and the sect of Mahomet began more than six hundred years after the Incarnation of Christ, as is evident from the difference between the Christian years and those of the Arabs, namely, 631 years and 195 days. But the years of the Arabs are computed from Mahomet, as Alfraganus states and others likewise.

If he is in conjunction with Mercury his reference is then to the law of Mercury. For Mercury, as they say, has reference to deity and to the oracular utterances of prophets, and to belief and to prayer, and particularly so when Jupiter is in conjunction with him; since he then signifies the number of the psalm and the number of the sacred books. They also say that the law of Mercury is harder to believe than the others, and contains many difficulties beyond the human intellect. This is in keeping with the difficult motions of Mercury, whose circuit is in an epicycle and in an eccentric circle and in a concentric one. In these motions we have to consider his motions in longitude and his curving and backward curving in his motions in latitude, owing to the declination of the eccentric circle from the Zodiac to the north and south, and of the epicycle from the eccentric circle in the direction of north and south, and they are more wonderful and difficult than all the other motions of the planets, as is clear from the statements of Ptolemy, and clearer still from those of Albategnus, Thebit, Archaselis, and Alfraganus. For this reason he has reference, as they say, to the law that contains difficult articles and hidden truths, of which kind is the Christian law. But because Mercury signifies writing and writers, and depth of knowledge contained in profound books, and eloquence or sweetness of speech and tongue, oratory and its rapid flow, and the explanation of sentences, he indicates that this law will be defended by such authentic scriptures and by so many profound sciences and by such potency of eloquence, that it will always remain firm in its own strength, until the

final law of the moon shall disturb it for a time. They say also that this is the law of the prophet who shall be born of a virgin, in accordance with the teaching of all the ancient Indians, Chaldeans, and Babylonians that in the first face* of the sign Virgo [the Virgin] there ascends a very pure virgin who shall rear a son in the land of the Hebrews, whose name is Jesus Christ, as Albumazar states in his larger Introduction to Astronomy. In morals his authority will be quoted among other authorities on matters pertaining to moral philosophy, because for the matters here mentioned mathematics gives preparation in the service of that philosophy, as will be set forth more expressly in that subject. The virgin birth of the prophet is in full accord with the law of Mercury, because Mercury was created in the sign Virgo, and the dignities or potencies or testimonies or virtues or five fortitudes which are due to the planets in relation to the signs, Mercury has in the sign Virgo, to wit, house, exaltation, triplicity, terminus, face.

Both in the present and in the former instance house is used in a double sense; since these houses are called essential and natural, those mentioned previously are called accidental and relating to position, since these houses are the twelve signs of which there is a natural division, because the sections of the Zodiac and of the heavens remain in their positions respecting the celestial circle, that is, the firmament, which division of the signs is made by six circles intersecting one another at the poles of the Zodiac, and dividing the whole heavens and the world into twelve equal parts. These parts can be considered on the Zodiac only, and then they are properly signs, like Aries and the others, or those circles in imagination can be extended to the poles, at which they intersect one another, and then they divide the whole heavens into twelve parts, narrow at their extremities around the poles and broad in the middle like the bottom of a skiff, so that the broad part contains the extremities of the parts of the Zodiac, which we call by the general name signs, as Aries [the Ram] or Taurus [the Bull], etc. It is taken also in another sense for the whole portion of the heavens contained between two circles crossing, let us say, through the boundaries of Aries and meeting at the poles of the world; and that sign is said to be the sign of Aries, because its breadth

* Face means one third of a zodiacal sign.

consists in the extension of Aries, and thus the stars outside the body of Aries are said to be in the sign of Aries, although they are near the poles of the world. But the other houses are called accidental, because their division is accidental, and the sections do not remain in the same place in the heavens, because they do not follow the motion of the heavens, and for this reason their positions change on the circle or in the heavens hourly. These sections are made, as has been said, by the meridian circle and the horizon together with four other circles. The house, moreover, that is called natural is twofold, one that is principal and one that is not principal. Moreover, the principal house of a planet is that in which it was created, as follows; Leo [the Lion] is the house of the sun, Cancer [the Crab] of the moon, Virgo of Mercury, Libra [the Scales] of Venus, Aries [the Ram] of Mars according to some, Scorpio [the Scorpion] according to others, Sagittarius [the Archer] of Jupiter, Capricornus [the Goat] of Saturn. These are, moreover, inferior [*minus principales*] houses, as follows; Aquarius [the Waterman] is assigned to Saturn, Pisces [the Fishes] to Jupiter, Scorpio to Mars according to one opinion, according to another Aries, Taurus [the Bull] to Venus, Gemini [the Twins] to Mercury; so that each of the five planets has two houses but the sun and moon only one each. So have the sages from antiquity decided.

Now these are the exaltations. The sun has its exaltation in Aries, the moon in Taurus, Saturn in Libra, Jupiter in Cancer, Mars in Capricorn, Venus in Pisces, Mercury in Virgo. Moreover, as the sun has its exaltation in Aries, so has it its descent in Libra, and likewise in the case of the others; and similarly the depression of Mercury is in Pisces, and therefore the exaltation of Mercury is in Virgo, just like his house, and this exaltation is in the fifteenth degree of Virgo. A planet is said to be in its triplicity when it is in the sign in which it was created, or in one of the same nature as the sign in which it was created. Whence we must note that there are four triplicities of signs. One is hot and dry, containing three hot and dry signs, of which kind are Aries, Leo, and Sagittarius. Hence when the sun is in any one of these three he is said to be in his triplicity. The second triplicity consists of Taurus, Virgo, and Capricornus, and is cold and dry; and Mercury when he is any one of these is in

his triplicity. Since although the owners of this triplicity are in the day first Venus, then the moon, and in the night first the moon, afterwards Venus, and Mars shares them in the night and in the day, yet Mercury has a share in them properly, as the astronomers say, and therefore has his triplicity in Virgo as well as his exaltation and house. The third triplicity consists of Gemini, Libra, and Aquarius, which is hot and moist. The fourth consists of Cancer, Scorpio, and Pisces, which is cold and moist.

More famous are the boundaries of the Egyptians; Jupiter has the first six degrees of Aries, Venus the following six, Mercury eight, Mars five, Saturn five, Venus in addition the first eight of Taurus, Mercury the following six. Thus with a wonderful diversity do these boundaries vary, as is evident in the table of boundaries, so that Mercury has the first seven degrees of Virgo for a boundary, not only according to the Egyptians, but also according to Ptolemy, and this is our present question. Faces of the signs, moreover, are determined by the division of each sign into three equal parts; and each one consists of ten degrees, which are called faces, and otherwise *decani.** The first face begins at the first degree of Aries and ends at the tenth degree of the same sign and is called the face of Mars. The second face reaches to the twentieth degree, and is called the face of the sun, because the sun succeeds him in the order of the orbits. The third extends to the end of Aries and is called the face of Venus, and so on with the others according to their sequences, as is shown in the table of faces, so that Mercury has the last ten degrees of Virgo for his face. Thus it is clear that Mercury has all these potencies in Virgo. They are called potencies through a similitude. Hence a planet in its own house is compared to a king in his royal house and in his domination; and when the planet is in its exaltation it is like the man in his honor and among his servants and ministers; when the planet is in its boundary, it is like the man in the midst of his parents, relatives, and family; and when it is in its face, it is like the man in his official position of command. House, moreover, is said to have five fortitudes, exaltation four, triplicity three, boundary two, face one. Whence house has in

* Chief of ten parts of a zodiacal sign.

itself the fortitudes of five faces, and exaltation has the fortitude of four faces and so on.

From these statements, therefore, it is clear that these potencies of Mercury essential and principal are all in Virgo. We must add that each planet has in addition a certain accidental potency in the sign belonging to it, which is called *gaudium* [joy]. Hence Saturn, when he enters Aquarius, is said to rejoice, as does Jupiter in Sagittarius, Mars in Scorpio, Venus in Taurus, and Mercury in Virgo. Therefore Mercury nowhere else has so much influence as in Virgo. Nor has any other planet so many rights of ownership in her, wherefore Mercury is assigned properly to Virgo. Therefore for this reason they say that the law of Mercury must be the sect of the prophet to be born of a virgin; and therefore this sect of Mercury is assumed by them to be the Christian law. If, therefore, he be in conjunction with the moon, teachers of astronomy say that the law of the moon will follow and be the last one, because the sphere of the moon is the last one, and this will be the law of corruption and a foul one, which shall do violence to the other laws and suspend them, even the law of Mercury for a time. For the moon, as they say, has reference to necromancy and deceit, and therefore the law of the moon will be devoted to necromancy, magic, and deceit. On account of the corruption of lunar motion and of lunar shapes it signifies the corruption of that law, which will be corrupt in itself and a corrupter of the others. It will not, however, last long, as they say, because the moon changes quickly in its shape, light, and motion, owing to the shortness of its orbit. This dominion, as they say, will be established by some one great and powerful, who shall prevail over others, and astronomers of our faith both modern and ancient consider that this is the law of Antichrist, because he finally at the end of the world will appear, and will bring in the law of corruption, and will infatuate the world by means of magic and his lies.

Thus, then, the astronomers distinguish the sects and in particular Albumazar in his book on Conjunctions, and especially in the first and in the second books, so that there are found to be six principal sects, in which are included the inhabitants of this world. By this means it is established that the sect of Christ is one of the principal sects. If we compare it with the others, it

is manifest by reason of the noble nature of its lawgiver and of the sect itself, that no other sect is worthy, but all others are the figments of men. This fact is at once apparent respecting the last law, because there is no truth in it. In the law of Venus, which is that of the Saracens, a delight in sin abounds according to its tenor mentioned above. But philosophy excludes sin from law. Likewise the law of the Egyptians is nothing, nor is that of the Chaldeans, because they teach men to worship a creature, and this philosophy denies. For worship is due to God alone, as will be explained under the topic of morals. The sect of the Jews, however, is less removed from the truth. But the lawgiver was not the son of a virgin, as in the Christian dispensation; and it is not confirmed by so many authentic Scriptures, nor has it such noble articles as we showed previously according to the philosophers. Therefore of necessity the law of Christ must obtain the leadership. But in moral philosophy this will be plain from its properties. For not only thus in general do astronomers investigate these laws, but they determine the times of their inception and the end of some of them. This investigation is made by means of the conjunctions of the planets and the revolutions of their motion. Albumazar, then, in his book on Conjunctions and other astronomers determine that there are three conjunctions of Saturn and Jupiter, namely, a great one, a greater, and the greatest. A great one happens at their conjunction every twenty years, in whatever sign it may take place. For Jupiter completes his orbit in twelve years, and Saturn in about thirty, and therefore it happens that after twenty years they are in conjunction in the ninth sign from that one in which they had previously been in conjunction; and after another twenty in the fifth from the first; and after the third twenty again in that first sign. This is a great conjunction, which occurs in this threefold manner twelve times, or sometimes thirteen times. For the first sign, the fifth, and the ninth make a triplication. This conjunction is said to have reference frequently to the elevation of kings and potentates and to dearness in the cost of provisions, and to the rise of prophets. After they have been in conjunction in this triple manner so many times that they change to another it is then called a greater conjunction. This happens every two hundred and forty years or thereabouts, and has reference to a sect and to its change in

certain regions. When the conjunction has changed from this triple form to another one, as from the end of Cancer to the beginning of Aries, it is then said to be the greatest one, through the revolution of Saturn thirty-two times, and happens every nine hundred and sixty years, and has reference to changes in empires and kingdoms, to impressions of fire in the air, to flood, earthquake, and dearness in the price of food. A conjunction of the greater or almost of the greatest type occurred in the twenty-fourth year of Augustus Caesar which wise astronomers said had reference to the coming law of Mercury. In the book concerning the change in Ovid's life which is named Concerning a Little Old Woman, because of whom the change had been made, Ovid is said to have spoken about this conjunction, and from its nature to have broken forth in admiration of the sect of Mercury destined to be introduced into the world by a prophet without human father, born of a virgin. He predicted that this sect would come into being six years after this conjunction, so that according to him the prophet would be born in the thirtieth year of Octavianus Augustus. For twelve years passed from the death of Julius to the battle of Actium, in which Octavianus Augustus obtained full power. For previously he worked to acquire the kingdom rather than actually possessed it. Christ then was born in the thirtieth year of Octavianus. If, however, those twelve years are reckoned as part of his reign, then was Christ born in the forty-second year of Augustus, as some count. But the result is the same. For Augustus waged five great civil wars in those twelve years, as the histories state, and in particular Orosius in his book Ormesta Mundi. The last one was at Actium, in which he defeated Antony and Cleopatra, and the empire rested in peace. Ovid, therefore, speaking of a conjunction of the greater or almost of the greatest kind, writes the following verses: "Such a conjunction occurred lately at a momentous time in the twenty-fourth year from the beginning of Augustus Caesar's reign, which signified that six years later a prophet must be born, without a human father, of a virgin, of whom there is thought to be a type when the influence of Mercury is increased. The early character of the future sect will accord with this influence, for nowhere else has Mercury so much power in respect to the signs as in the sign of the Virgin."

The first face of Virgo was ascending in the east when that

conjunction happened. The conjunction was near the head of Aries. For if we revolve the motions of Saturn and Jupiter to that time, we shall find that they were in conjunction by their mean courses six years, five days, and three hours before the birth of Christ; and the mean course of both was in Aries ten degrees, fifty-six minutes, fifty-two seconds. Now the mean motion of the eighth sphere was ten degrees, five minutes, fifty-one seconds, twenty-seven thirds of the signs of the small circle, and had to be subtracted from the positions of all the planets; whence there remained from Aries two degrees, fourteen minutes, forty-two seconds. Since, therefore, the difference between two conjunctions by their mean courses adds eight signs, two degrees, twenty-five minutes, seventeen seconds, it follows that the preceding conjunction had been in Cancer nine degrees, fifty-one minutes, twenty-five seconds, and thus was the triplicity changed from a watery to a fiery sign. If, however, this conjunction had been nearer the head of Aries, it would have been one of the greatest kind, and then were completed 305 years and nine months, and about twenty-three days, of the Greeks, as can be proved by the tables of years.

By means of the revolutions of the motions of the planets they calculate that same matter. For Albumazar in the eighth distinction of the second book on Conjunctions says that the retarding of sect and of empire and changes in them occur particularly according to the space of ten revolutions of Saturn, especially if for Saturn a change should occur at the signs bringing change, which are Cancer, Libra, and Capricornus, provided Jupiter is setting away from him. But if Jupiter is with him, or is looking toward him, he will greatly lessen the evil owing to his own goodness. For when ten revolutions of Saturn were completed in the days of Darius, Alexander the Great appeared, and the destruction of the kingdom of the Persians took place. After approximately ten other revolutions were completed Jesus, son of Mary, appeared, in regard to whom there are rescripts with change of faith. When ten others were completed Manes appeared, coming with a law which is in force among the Pagans and the Nazarenes. After ten others came Mahomet, an event perhaps before the completion of ten revolutions, as in the ninth revolution, and perhaps after them, as in the eleventh. This is in accordance with the space required by

the conjunctions preceding, which are stronger than those revolutions. Similarly a sect is changed more quickly or slowly according to the properties of the planets bearing sway over different regions, as follows: Saturn controls India; Jupiter, Babylonia; Mars, Thrace; the sun, the Romans and their empire; Mercury, Egypt; the moon, Asia.

Concerning the destruction of the law of Mahomet they speak clearly and with certainty. For according to what Albumazar says in the eighth chapter of the second book, the law of Mahomet cannot last more than 693 years. But so long is it able to last and will last, unless owing to some coincident cause, the time shall be shortened as we explained before, since a shortening can take place greater or less from different causes. It is now the six hundred and sixty-fifth year of the Arabs from the time of Mahomet, and therefore it will be quickly destroyed by the grace of God, which must be a great consolation to Christians. Wherefore God is to be praised, who has given the light of wisdom to philosophers, by which the law of truth is confirmed and strengthened, and by which we perceive that enemies of the faith must be destroyed. With this view the Apocalypse agrees in chapter XIII. For it says that the number of the beast is 663, a number less than that predicted by thirty years. But Scripture in many places takes something from a complete number, for this is the custom of Scripture, as Bede says. Perhaps God willed that this matter should not be explained fully, but should be somewhat veiled, like other matters which are written in the Apocalypse. Whence before the final time which is determined for that sect, according to its principal cause, as Albumazar determined it, it may happen that the Saracens will be destroyed by the Tartars or Christians. Already the greater part of the Saracens have been destroyed by the Tartars, as well as the capital of their kingdom, which was Baldac, and their caliph, who was like a pope over them. These things happened twelve years ago.

Although they make these statements regarding sects, and sects depend on the freedom of reason, yet they do not place any necessity on freedom of the will, saying that the planets are signs hinting to us those things which God arranges from eternity to take place either through nature, or through human will, or by his own plan in conformity with the good pleasure of his

will. Such is the statement in the book on the Courses of the Planets. Moreover, they state that the will is not under compulsion, but the body, however, is altered by the forces of the heavens, and then the soul united to the body is excited strongly and influenced effectively, although it is in no way compelled, so that it desires gratuitously to follow the inclinations of the body toward actions private or public, and to good ones as well as to evil ones, so that thus opinions and sects and changes in customs are introduced by some person famous among the people and powerful, in accordance with what was seen and known beforehand by God; so that the planets are thus not only signs, but do something in the way of excitation.

Since they have maintained that Jesus Christ is God and man, as the astronomer Ethicus clearly states in his Cosmography, and likewise Alchimus, and, moreover, in that book inscribed, *Ovidius de vetula,* the conclusion is drawn that God is incarnate in Christ, attributing to him, as they do, what is denied to man alone, their contention is that a celestial arrangement could have taken place for a sign of the conception of the Virgin and of the nativity of that Man, so far as he was man. In the same way a star gave a sign at his Nativity, in accordance with which the statement is made in the book on the Courses of the Planets, that all the planets and other stars serve in one way God made man, in another way pure man; in one way the Creator, in another creatures. Therefore God has willed so to order his affairs, as to show by means of the planets to rational souls certain things which he saw beforehand and predestined to happen, with the intention doubtless that the human mind, recognizing the wonders of God, might grow, inflamed to a love of its Creator. Therefore they maintain that the heavenly bodies are able to presage and signify this divine work of the conception and nativity, so that the creature may bear witness to its Creator coming in the flesh. Just as the sun was darkened, contrary to nature, at the Passion, wherefore the philosophers seeing these things said that either God conceded something to nature or the whole frame of the world would be dissolved. Without doubt they maintain that it is impossible for God to be subject to a creature, and that that divine work, in so far as it was from an infinite virtue and above nature, in no way was subject to a celestial arrangement; but that it had

merely served for a sign. Yet in so far as the most pure Virgin was the true and natural mother of our Lord Jesus Christ, and functioned according to the force of nature in preparing in advance substance and in fostering it after conception and in like actions, they have maintained that the force of the heavens coöperated with the natural force of the glorious Virgin and aided her in so far as she functioned according to nature, because man begets man. For if there was anything of a natural character in that conception through preparation of substance and nourishment in the womb and the like, in so far as she was true and natural mother, they do not consider it improper to assume that the celestial arrangement is more than a mere sign, taking into account simply the things of nature. But whatever statement they make in this matter, must be reduced to the rule of faith, so that it may not be out of accord with catholic truth. Although all things do not suffice to show fully the secrets of that sect, yet they give convincing evidence on the question whether this is a sect, and also in regard to its quality in general, so that in our admiration of the wisdom granted to them we easily excuse their ignorance in falling short of full certification of Christian rite, since they had not been instructed in it. We should praise them because they agree with us and confirm our profession. But in the third part of the moral philosophy there will be a fuller discussion concerning this confirmation.

Since after the law of Mahomet we do not believe that any other law will come except the law of Antichrist, and astronomers likewise agree in this, that there will be some powerful one who will establish a foul and magical law after Mahomet, which law will suspend all others, it would be a very useful thing for the Church of God to take thought concerning the time of this law, whether it will come quickly after the destruction of the law of Mahomet, or much later. The philosopher Ethicus in his Cosmography states expressly that a race which has been shut within the Caspian gates,* will burst forth into the world, and will meet Antichrist and will call him god of gods. Without doubt the Tartars were within those gates and have gone forth. For already the gates have been broken, as we know. For Franciscans, whom the present lord king of France,

* Narrow passes in the Taurus.

Louis, sent, crossed with Tartars through the midst of the gates far beyond into the mountains where they were shut up. It is known not only to all nations of the East that the Tartars have gone forth from those localities, but also to those who are well acquainted with the geography of the world, and know its habitable parts and the differences in regions by means of astronomy and through authors like Pliny and Martianus and others who describe the regions of the world, and also by means of the histories. I do not wish in this matter to be presumptuous, but I know that if the Church should be willing to consider the sacred text and prophecies, also the prophecies of the Sibyl and of Merlin, Aquila, Seston, Joachim, and many others, moreover the histories and the books of philosophers, and should order a study of the paths of astronomy, it would gain some idea of greater certainty regarding the time of Antichrist.

But these matters may now be dismissed. I shall now introduce a subject not only in accordance with its advantage, but also its appropriateness to the Church, a subject without which great peril and confusion cannot be avoided; although for long periods there has been manifold abuse in this matter. Since all this error proceeds from pure ignorance and negligence in its study, it is so much the more contemptible in the sight of God and of holy men, and in the sight of all men as well as of learned astronomers. But even ordinary computers are aware of the manifold error, and write in regard to it as well as do astronomers. The writings of both these classes are circulated throughout the Church of God, in which these errors are noted and advice is given in regard to their removal.

The matter I have in mind is the correction of the calendar used by the Church. Julius Caesar, instructed in astronomy, completed the order of the calendar as far as he could in his time, and, as the histories state, he disputed against Achorius the astronomer and Eudoxus his teacher in Egypt regarding the length of the solar year, on which our calendar has been based. Hence, as Lucan states, he himself said, "My year shall not be conquered by the calendar of Eudoxus."

But Julius did not arrive at the true length of the year, which he assumes to be in our calendar 365 days, and one fourth of a day. This fourth is summed up through four years, so that in leap year it is reckoned as one day more every fourth year

than in other ordinary years. But it is clearly shown by all computers ancient and modern, and rendered certain by astronomical proofs, that the length of the solar year is not so great, nay, less. This deficiency is estimated by scientists to be about the one hundred and thirtieth part of one day. Hence at length in 130 years there is one day in excess. If this were taken away the calendar would be correct as far as this fault is concerned. Therefore, since all things that are in the calendar are based on the length of the solar year, they of necessity must be untrustworthy, since they have a wrong basis.

In the second place, there is another greater error, namely, regarding the determination of the equinoxes and solstices. For this error arises not only from the length of the year, but has in itself grave errors. Moreover, the equinoxes and solstices are placed on fixed days, as if they had always occurred on them and must continue to do so for ever. But astronomers are certain that they are not fixed, nay, they ascend in the calendar, as is proved without doubt by tables and instruments. At the beginning of the Church the winter solstice was placed on the eighth day before the Calends of January on the day of our Lord's Nativity, and the vernal equinox on the eighth day before the Calends of April on the feast of the Annunciation of the Glorious Virgin, and the summer solstice on the eighth day before the Calends of July, namely, on the day of the nativity of the blessed John the Baptist, and the autumnal equinox on the eighth day before the Calends of October. Of this opinion was Hippocrates the physician; with whom Christians easily agreed, because the blessed John said, "He must increase, but I must decrease." Hence some expounders of sacred Scriptures have maintained that the Lord was born when the day increases, and this happens at the winter solstice; and that John Baptist was born when the days begin to decrease, that is, at the summer solstice. Isidore held this view of Hippocrates, as is clear from the eighth book of the Etymologies, also Saint Anatolius, who at the beginning of the Church discussed matters of this kind; but later ecclesiastics changed these dates, and decided that the vernal equinox is on the twelfth day before the Calends of April, as Bede states in his book on Chronologies, and this date is still the accepted one. This is clear to all who know anything about computation, and who consider the prac-

tice of the Church. For as under the old law the Passover was celebrated after the vernal equinox when there had been the fourteenth moon, so the Church decreed that Easter should be reckoned from that date, and be observed on the Sunday following; because of necessity this feast among Christians must fall on a Sunday, and for this reason we are not able to celebrate Easter on the day of the fourteenth moon, but on the Sunday following. They have maintained that the earliest Easter is on the eleventh day before the Calends of April, that it cannot happen before that date, because the equinox, they said, is fixed on the twelfth day before the Calends when the moon can sometimes be the fourteenth. For as Bede says in his computation, the Church does not consider the fourteenth moon which precedes the equinox, but that which is on the equinox or after it; and the equinox itself, as he says, is on the twelfth day before the Calends of April, and from this date is Easter reckoned, as all computers know: because if it falls on the Sabbath then on the day following Easter can be kept, because this day is Sunday. Therefore because of the fixed date of the equinox on the twelfth day before the Calends of April, the Church says that the earliest Easter is on the eleventh day before the Calends of April.

But although the Church in its practice in the beginning held that the equinox is on the eighth day before the Calends, and later changed the date, and now considers the equinox as fixed on the twelfth day before the Calends of April, yet it is certain that the equinox is not on those dates, but is ascending in the calendar far from them, and likewise the solstices and the other equinox. For this year the winter solstice was on the Ides of December, twelve days before our Lord's Nativity, and the vernal equinox on the third day before the Ides of March, and the summer solstice is on the seventeenth day before the Calends of July, and the autumnal equinox on the sixteenth day before the Calends of October. This fact can not only the astronomer certify, but any layman with the eye can perceive it by the falling of the solar ray now higher, now lower, on the wall or other object, as any one can note. They will be changed from these dates in subsequent times, because after about ninety-four years, that is, in the year of our Lord MCCCLXI, the winter solstice will be on the day before the Ides of De-

cember, and the vernal equinox on the fourth day before the Ides of March, and the summer solstice on the eighteenth day before the Calends of July, and the autumnal equinox on the seventeenth day before the Calends of October; that is, each of these will be one day earlier than it is at present. For after about 125 years it comes a day earlier. This happens from the error in the length of the year, because the sun lacks by one day in about so much time the length of a year. And this is because it accords better with the years which we reckon from the Incarnation. For Ptolemy, in the one hundred and fortieth year, found the vernal equinox on the eleventh day before the Calends of April and the winter solstice on the eleventh day before the Calends of January, as is clear from the Almagest. But from this position in the calendar to the Ides of December, when the solstice now happens, are nine days by which this solstice has risen in the calendar. But from the year of Ptolemy's verification there are now 1127 years of our Lord, because the present year is the twelve hundred and sixty-seventh, from which if there are subtracted the 140, which passed from the Incarnation to the verification of Ptolemy, there will remain 1127 years. But in this time just stated 125 years will be found nine times and two years over. Wherefore this time, namely, 125 years, is in sufficient agreement with the number of years of the Christian era, so that always one day in such a period of time should be substracted from the length of the year, and denote the change in the solstice and equinox.

I protest, however, that in so great a difficulty I am not speaking in precise terms, but there is much at hand to attest the truth, until a final determination is reached in regard to the length of the year and the change in the solstices. By what has now been said, however, according to the verification of Ptolemy the winter solstice could not have occurred on the eighth day before the Calends at the time of the Nativity of our Lord, but must have been on the tenth day preceding the Calends; because in the 140 years from the time of the Nativity to the verification of Ptolemy the solstice could not have changed three days, nor two, but one and a small part of another. Therefore the tenth day before the Calends of January could have been, according to Ptolemy's discovery, the eleventh before the Calends. Since by this same verification of Ptolemy

the equinox could have taken place in the first year of the Nativity on the eleventh day before the Calends of April; it could not have been on the eighth, as was at first the belief of the primitive Church, and still more was it impossible for it to happen on the twelfth day before the Calends of April, as is now the belief according to the usage of the Church. Because since the equinox is always mounting in the calendar, and in the time of Ptolemy was on the eleventh day before the Calends of April, previous to that time it was after that date and nearer to April. According to these facts, therefore, neither are the equinoxes and solstices fixed, nor are they fixed on those days set by the Church. Nor was Hippocrates far from the truth, since he was more than three hundred years before Christ, and therefore the equinox could have happened in his times on the eighth day before the Calends, or nearly so, namely, on the seventh.

But the third disadvantage is a far greater one. For, as we have shown, the truth is that without error Easter ought to be celebrated on the Sunday after the fourteenth moon which is found either on the equinox, or after the vernal equinox, because of the conformity of the Christian law to the old law, after the observance of the Passover, which in the first place was in the old law, and preceded as a figure of the new Passover. Since, therefore, it is true that the equinox is on the third day before the Ides of March, and it is possible that on that date occurs the fourteenth moon, namely, in the fourteenth year of a nineteen-year cycle, so that the first moon is reckoned on the day before the Calends of March above the letter C, Easter must of necessity be on the Sunday next after that day in accordance with the truth. But from this fourteenth moon Sunday cannot be farther distant than up to the thirteenth day before the Calends of April, as is manifest in the Calendar. But this is before the eleventh day before the Calends of April on which the Church celebrates the earliest Easter. Wherefore in that fourteenth year of the cycle glorious Easter will be observed at the wrong time. The same thing occurs in the third year of the cycle, as is shown by the golden number on the Calends of March. For Easter will happen on the twelfth day before the Calends of April or short of it. Since Sunday in these years can happen on the day before the Ides of March, and on the

Ides, and so on, up to the twelfth day before the Calends of April, therefore, for various reasons should Easter be observed on those days, which cannot be if the earliest Easter is on the eleventh day before the Calends of April. Since, moreover, the true equinox mounts more and more in the calendar, about the fourteen hundred and eighty-first year it will be on the fifth day before the Ides of March. The equinox will in this way approach continuously the beginning of March, and will pass out of March, due to the error in the length of the year. Easter will then have to be observed around the first of March or in February, and in this way its observance will always come at an earlier date in accordance with the earlier date of the equinox. But this is a most serious disadvantage; because thus not only Easter, but Lent and all the movable feasts will recede in a shocking manner from their positions and the whole order of the ecclesiastical office will be confused. Moreover, since as a matter of fact Easter can be observed before the eleventh day before the Calends of April in accordance with the truth respecting the equinoxes, and this by many days, and by as many as we wish, according to the earlier date of the equinox, of necessity the true beginning of Lent likewise ascends in the calendar in like fashion before it begins according to the usage of the Church, and thus in the real Lent meats will be eaten for many days; and to such an extent is it possible for the date of the equinox to be advanced that the whole of the true Lent will be at a time when Christians will be eating meats, which is very absurd. In this way the Easter feast, by which the world is saved, and the feast of Pentecost, by which the grace of God is diffused in the Church, and the other movable feasts suffer violence; and consequently the other immovable feasts are disturbed also, because they yield to Easter and to the other feasts of its class, as is clearly known. Since these are dreadful things in themselves, they are the more foolish and worthy of derision; since owing to ignorance and negligence the devil has brought about this state of affairs in the Church of God. For it would be necessary only to verify the length of the year and the equinox. If the verification of the length of the year is conceded to the most skillful astronomers, yet is it easier to verify the equinox, because in approximately 120 years it changes only by one day according to the more approved opinion in these

days. Scientific skill would be available in this matter, and the equinox could be found for all future ages to the end of the world and beyond, an easy task, and tables could be made and a canon regarding it, and published throughout the whole Church of God, and placed with the calendar, and then would there be no obstacle in this particular. Likewise the other equinox could be found, and the solstices with ease, and all error in these matters would be eliminated to the praise and honor of God, and evil report and stumblingblock be removed, which are at present numerous among all computers and astronomers and scientists owing to the errors which in this matter are permitted by the Church to be spread abroad.

But a greater disadvantage comes from the beginning of lunation, as given by the golden number in the calendar. For any one can see with the eye, if he looks at the sky, that the new moon occurs as a matter of fact three or four days before it is marked in the calendar, and every seventy-six years the beginning of lunation recedes from its place in the calendar sixteen minutes* of one day and forty seconds, and this is more than a fourth of one day, and nearly a third of a day, because sixteen minutes and forty seconds are six hours and forty minutes of one hour. In every 304 years it recedes from the place of first lunation in the calendar one day and six minutes of a day and forty seconds. After 4256 years the moon, according to the calendar, will be called new when it is full of light. After 7904 years there will be an error of one whole lunation, with the exception of a small part, namely, thirty-eight minutes and thirty seconds. This error can reach to one hundred lunations, and then again the first error will return, so that successive ones may follow in order, and thus these errors roll around forever. Skillful astronomers have no doubt that all these statements are facts. Moreover, every computer knows that the beginning of lunation is in error three or four days in these times, and every rustic is able to view this error in the sky.

As briefly as I can, I shall give a general exposition of the errors mentioned. Our calendar assumes a cycle of nineteen years to be equal to nineteen solar years taken with a whole fourth, and accordingly the calendar uses a solar year of this kind, as we have explained previously. This cycle contains all

* See Bridges' note, Vol. I, p. 275.

the lunations which happen in nineteen lunar years. These are reckoned as 235, because in any lunar year, which is called common, we have twelve lunations, and to these we add seven lunations in a whole cycle of nineteen years to make up deficiencies, which occur in twelve lunations with respect to the twelve solar months in a solar year, because the lunar year consisting of twelve lunations has only 354 whole days, and the solar year eleven more, for it has 365. Therefore the lunar year ends eleven days sooner than the solar year; and then those eleven days in excess are collected together up to the third year, and one lunation or lunar month is formed. Thus in the third year of a cycle a lunar month is placed, and is called intercalary and the year an intercalary one, that is, an excess year, because it has thirteen lunations; and so on through the whole cycle are collected these intercalary months, so that they become intercalary years, in order that a nineteen-year cycle of lunations may be equal to nineteen solar years. For according to Ptolemy in the Almagest and all other astronomers the lunar month is not properly reckoned from the sight of the new moon, since this time is unequal: because sometimes in the morning of the same day there is the crescent form of the old moon, and in the evening the crescent of the new moon, and sometimes there is a space of two days between them, and at other times three days intervene, as is plain to the sense, and the reasons are given by astronomers; but months should be equal. Likewise, it does not begin with the conjunction of the sun and moon according to their true course, because this time is unequal; and therefore it will be reckoned with respect to the conjunction of the sun and moon according to the mean and equal course of each, because this time is equal and uniform. According to the proof of Ptolemy in the Almagest, this time is twenty-nine days and thirty-one minutes of one day, and fifty seconds, and eight thirds, and nine fourths, and twenty fifths. Arzachel agrees with this who based his tables on the length of a lunar year containing 354 days and a fifth and a sixth of one day, that is, twenty-two minutes. According to this the time of an equal lunation will be twenty-nine days, and thirty-one minutes, and fifty seconds, which multiplied by twelve make 354 days and twenty-two minutes. But Arzachel omitted the thirds and

fourths and fifths of Ptolemy, because in a very long period of time they amount to but little.

If we assume, then, the time of equal lunation is twenty-nine days, and thirty-one minutes, and fifty seconds, it happens that the least time reducing whole lunations to the same beginning of time is thirty years of the Arabs, which contain 360 whole lunations; and this period contains 10,631 days exactly. Since as one lunation is twenty-nine days, and thirty-one minutes, and fifty seconds, twelve lunations, which make one year of the Arabs and one lunar year, will contain 354 days and twenty-two minutes of one day. But 354 multiplied by thirty make 10,620, and twenty-two multiplied by thirty make eleven whole days, which added to the preceding make 10,631, reducing first equal lunations to a similar beginning of time. Since, therefore, thirty years of the Arabs form the least time which reduces whole lunations to a similar beginning of time, it is not possible that any other time should do this, unless it be equal to this time or a multiple of it. But twenty-nine years of our calendar are not equal to thirty years of the Arabs, nor a multiple of them, because thirty years of the Arabs contain twenty-nine solar years, and one month, and eight days. Therefore it remains that nineteen solar years cannot equal a true cycle of first lunations, nor consequently the nineteen years of the nineteen-year cycle. Therefore the nineteen-year cycle is not a true cycle of first lunations.

Moreover, this fact can be made clear in greater detail, so that the disadvantages mentioned above may be apparent. For successive periods of nineteen solar years are not of the same length, because in the first cycle there are only four leap years, and in three others there are five, because the fourth year in the first cycle is a leap year, and the eighth, twelfth, and sixteenth, because the fourth year is always a leap year. Therefore in the second cycle the first is a leap year and so on, so that in this cycle there are five leap years, as is clear to any one considering the matter, and likewise in the other two; and then the cycle returns again which has four leap years, and the three follow which have five and thus continually does the order of cycles proceed. The first cycle of nineteen solar years has exactly 6939 days, and in these years are assigned 235 lunations. But if we multiply the period of an equal lunation, that is

twenty-nine days, and thirty-one minutes, and fifty seconds, into 235, the result will be 6939 days and forty minutes and fifty seconds, which are more than two thirds of one day. Wherefore after the completion of nineteen years containing only four bissextile days, 235 lunations are not yet completed, but lack forty minutes and fifty seconds of one day. But any period of nineteen years having five bissextile days contains 6940 days. Hence since 235 equal lunations have 6939 days and forty minutes and fifty seconds, nineteen years with five leap years exceed 235 lunations by the space of nineteen minutes and ten seconds, which is about one-third of a day. This is manifest, if from the one day by which the nineteen years first mentioned exceed the 235 lunations there are subtracted the forty minutes and fifty seconds, by which those lunations exceeded the nineteen years with only four bissextile days. Thus is it evident that periods of nineteen solar years are not equal to one another in turn. But four times nineteen years, making seventy-six years, return to the same beginning in time, and are always equal to other periods of seventy-six years. If, then, there are accumulated three times the nineteen minutes and ten seconds, which every period of nineteen years with leap years adds in excess of 235 lunations, there will accrue for us fifty-seven minutes and thirty seconds, by which those thrice nineteen years with five leap years taken together exceed their lunations. But nineteen years with only four bissextile days are less than their lunations by forty minutes and fifty seconds. If, therefore, these forty minutes and fifty seconds are subtracted from the aforesaid fifty-seven minutes and thirty seconds, there will remain sixteen minutes and forty seconds, by which four times nineteen solar years, making seventy-six years, exceed their lunations.

This is the first notable error, which I noted at the beginning, from which follows the second. For if we take four times seventy-six years, making 304 years, they will exceed their lunations by four times sixteen minutes and forty seconds. But these taken four times make one day and six minutes and forty seconds. There remains then the second error that 304 years exceed their lunations by one day and six minutes of one day and forty seconds. Therefore it happens that after 304 years according to the calendar we call the moon the first, although

the existing one is of greater age to the amount of one day and six minutes and forty seconds. If these are facts, it is manifest to the inquirer that with the multiplication of time will be multiplied the inconveniences. Therefore after 4256 years according to the computation of the calendar the moon will be denoted as new when it is filled with light. And further, one whole lunation will superabound; and at length a hundred lunations in a very great period will be in excess, as is manifest by the principles just given. Nor is it necessary to make greater computations for the present plea, since proofs are ready for this matter, when the fitting time arrives. Very manifest, then, is the error of first lunations according to the calendar, and not a single one but multiplex, nor small but well-nigh infinite.

Since, moreover, the error of the nineteen-year cycle is in the separate years, it follows that likewise will there be an error in the cycles of epacts. For the eleven days in a solar year in excess of a lunar year are called the epact of the following solar year, as it were, *epiaucta,* that is, additionally increased; and by those eleven days is the age of the moon increased on the first day of the following year, and by the same days is the age of the moon increased at the beginning of each month of the coming year beyond its age at the beginning of each moon of the year prior. Because of the existence of these errors, of necessity the true age of the moon must be ascertained by other means than cycles of this kind.

The remedy for all these ills is found in the fact that we are able to learn the primation of the moon according to astronomical truth if we count time according to the years and months of the Arabs; because the first day of each month of the year of the Arabs is the day of the conjunction of the sun and moon according to the mean course of each. Hence if we desire to call this day the first day of the age of the moon, then when the beginnings of the months are known the beginnings of lunations are also known. But if we wish to begin our first lunations on the first day of the visible moon or on the second or third, we shall begin our lunations with the second or third day of each month of the Arabs, and we shall proceed uniformly in the computation of lunations and we shall encounter no error. Because the knowledge of the years of the Arabs and the beginnings of their months will give us the true knowledge of the

beginnings of lunation, all we need do then is to have recourse to the tables and canons of the years and months of the Arabs. I make this statement in accordance with the scientific principles which are the common property of Latin and Arabic astronomers. If, however, we should wish to proceed in another way, we can with the same certainty but on greater authority prove what we wish, namely, by means of the tables of the Greeks and especially of the Hebrews. For from the beginning the Hebrews have been very skillful in the knowledge of astronomy; and all nations have obtained this science as well as the other sciences from them, as I proved in what preceded. Therefore, if any one will consult the tables of the Hebrews for the setting of the sun at Jerusalem, he will find the truth in such matters.

But although the errors I have mentioned are terrible in themselves, yet they bear no comparison to those which follow from the facts now stated. For the whole order of Church solemnities is thrown into confusion by errors of this kind respecting the beginning of lunation according to the Calendar, as well as by the error in determining the equinoxes. And not to refer to other years for evidence of this error, I shall state the case in this present year. For not only the mean conjunction of the sun and moon this year was on the sixth day before the Calends of April, above the letter B, but also the moon's first illumination and appearance. Therefore the moon was the fourteenth on the fifth day before the Ides of April, above the letter A, and the fourteenth moon is the terminal date of Easter, and the Sunday following is Easter. Wherefore at the letter B following, namely, on the morrow, that is, on the fourth day before the Ides of April, should be Easter as a matter of fact. But it will be transferred eight days farther on owing to the beginning of lunation taken according to the golden number. For the golden number of this year is fourteen, which is placed on the third day before the Calends of April above the letter E, and there the beginning of lunation is said to take place according to the calendar. Therefore according to this the fourteenth moon, which is the terminal date of Easter, is the day before the Ides of April, and on the Sunday following is Easter placed, namely, on the fifteenth day before the Calends of May, and thus eight days beyond the true date. Wherefore the feast of

Easter, by which the world is saved, will not be celebrated at its proper time, but there is fasting this year through the whole true week of Easter. For the fast continues eight days longer than it should. There follows then another disadvantage that the fast of Lent began eight days too late; therefore Christians were eating meats in the true Lent for eight days, which is absurd. And again then neither the Rogations nor the Ascension nor Pentecost are kept this year at their proper times. And as it happens in this year 1267, so will it happen the year following. For according to the golden number Easter will fall on the fourth day before the Ides of April in the year of our Lord 1268. But it should be on the third day before the Nones of April, eight days earlier, because the first moon is three days earlier than it is given by the golden number. Therefore on the fourth day before the Calends of April, or at least on the third, will occur the fourteenth moon, which is the terminal date of Easter; wherefore the first Sunday following will be the day as a matter of fact. Just as it happens this year, so also more frequently can it occur through the earlier date of the equinox and of the beginning of lunation, that Easter will be celebrated not only eight days, but many more before it should, also the other feasts, just as we explained before in regard to the equinox. For after a long period of time it will happen that the moon is called new when it is at any distance whatever from the sun, as we explained before in the errors in the beginning of lunations. Therefore a very great inconvenience and an intolerable one will here follow.

Since, then, all astronomers and computers can see these errors, and every man who is willing to investigate the truth can see them, it should be necessary and required and well pleasing to God and desired by all men of science that the remedy be applied. The remedy would be an easy one; for the true equinox would be found by the tables of astronomy and by instruments, and the beginning of lunation would be attested by the same means, so that all kinds of the aforesaid errors would be eliminated, and the fourteenth moon from the equinox would be taken, whether it fell on the day of the equinox or after it, and there would be the terminal date of Easter, so that Easter day would fall on the Sunday following. Therefore the golden number would not have to be followed as something

fixed regarding the Calends. Tables, moreover, could be made for the beginning of lunations and for the equinoxes, and in accordance with these could the Calends be arranged in the year and in the months, following a similar device used by the Hebrews.

But in opposition to this it may be said that the Council of Nice decided that the paschal beginnings of lunation should be found according to the nineteen-year cycle. The blessed Pope Leo, when this dispute was under discussion, decided to adhere to the opinion of the Council of Nice. Bede also in his book on Chronologies in chapter XLIII strives as far as he can to prove correct this cycle and the beginnings of lunation occurring through the course of this cycle. For he introduces the authority of the Council of Nice and of Pope Leo and cites a miracle. For when many maintained at a certain time that Easter should be celebrated on the eighth day before the Calends of April, and others on the tenth day before the Calends of May, as the order of the nineteen-year cycle required, the dispute was settled by means of a certain baptistery, in which on the night of Easter yearly the sacred font was filled with water of itself, and after the people had been baptized the water went away as it had come. This happened on the tenth day before the Calends of May as the reckoning of the cycle required, and not on the eighth day before the Calends of April.

But if these things are rightly understood they do not contradict the truth. For when Eusebius, bishop of Caesarea, first arranged this cycle, he was very little prior to the Council of Nice, so that as his arrangement of this cycle was in correct accordance with the course of the moon at that period, there could not have been a sensible change at the time when that sacred Council was held. Therefore the holy fathers decided that the cycle be followed, because it did not at that time contain error, nor for a long time thereafter was it notably in error. Hence since Pope Leo was subsequent to the Council of Nice about one hundred and twenty years, under the Emperor Martian, it is manifest that the beginning of lunation cannot have receded from its place in the calendar from the time of Eusebius more than one day. Since the Pope himself discussed this error, he at least gave posterity the opportunity of considering the truth in this matter. But the error was a new one

and not very great, and the Council of Nice was of great authority, for which reasons it was not expedient at that time to go contrary to the decision of this Council.

Moreover, he did not find astronomers in the Church equal to this task, because from the beginning astronomy was hateful to Christians for the reasons stated above, namely, in the second part of this treatise. Nor yet up to the present have any been found to give the remedies in this matter. For there were many who knew how to prove those errors by astronomical means, and to what extent there is error; nor is this surprising, since our vision shows many of them to us; and in general they have stated what the remedies were, namely, that the length of the year should be attested, that the equinoxes and solstices should be accurately determined, and the beginning of lunations likewise; and they discuss the general methods applicable to these matters. But no one has yet given us the true length of the year, with full proof, in which there is no room for doubt. Nor have they given us what we require in respect to the other questions involved. Therefore, it was not strange if these things were not attested in the times of the early Church, when mathematics was reprobated among arts under suspicion and useless to the Church of God, like many other noble sciences, owing to the five reasons noted in the first part of this work. The Council of Nice decided that the cycle should be followed while it contained the truth, and because in those times it was not in error. But it decided that this should be observed, in order that the contention arising from individual judgment might be avoided, until there should be in the Church of God the potency of mathematics, by which all things in dispute can be attested. For it is an incomparably lesser evil that a single inconvenience should be borne for a time owing to the impossibility of a remedy, than that one should promulgate his own opinion equally as false as the one held commonly by all. So speaks Bede. For he says, "When they thus determined the moon according to the reckoning of the cycle, they avoided another greater peril by this means." And as to the fact that Bede adduced a miracle, it must be conceded that in those times there was no error in the cycle, as is manifest, but later an error grew and appeared sensibly.

Also the fact that he adduces the case of the stone selenite, whose splendor increases with the moon in the beginning of the

month and then decreases, by which in ancient times they learned the beginning of paschal lunations, is not an argument in favor of the cycle except while it was correct, but rather the reverse; because that stone shows us the true equinox, and the fourteenth paschal moon at or after it to be taken as the terminal date of Easter, which this cycle in these times cannot do, nor will it ever do so, nor has it done so for a long time in the Church. But Bede lived about the time of the introduction of the cycle. For he himself states that in his computation he at that time had reached the seven hundred and first year of our Lord. From the Incarnation up to the times of Constantine, under whom the Council of Nice was held, they were, according to Bede, 332 years. And from this time to the Emperor Martian there were 120 years, under whom was Pope Leo, which are in all 452 years. From this it is evident that Bede was not 300 years later, but even from the Council he was distant only 359 years, and for this reason the lunation could not have receded much from its position. For the recession could not have been more than one whole day and part of a second, because in 304 years there is a change of one day. Therefore for the reasons discussed above the cycle could have been followed properly in the time of Bede, just as well as in the time of Pope Leo. But, however, from the time of Leo a scruple of doubt has arisen, and this doubt was increased in the time of the blessed Pope Hilary, who directed Victorius to compose a new cycle, in which, since there was no certainty, even as there was none in the nineteen-year one, posterity has adhered to ancient custom and to the decree of the Council of Nice.

It is evident from these facts that, without impairing the full authority of the Council of Nice, this cycle can be changed; because at that time there was no error, and the cycle was kept, that a greater danger might for the time be avoided, until the Church should be able to have the aid of astronomy, by which alone the remedy can be applied. For the early Church did not have the advantage of astronomy. Therefore subsequently, up to the present, has the correction of this matter not been made because of long custom, and because the study of astronomy was not taken up by prelates and by the great body of students, nor is it pursued up to the present; although there are some quite able and skillful in this particular. But at the present time

the remedy must be applied because of those manifest and palpable errors, and because of the great discredit brought upon the Church. For all those trained in computation and all astronomers know these things, and deride the ignorance of prelates who maintain them. Unbelieving philosophers also, Arabs, Hebrews, and Greeks, who dwell among Christians, as in Spain, Egypt, parts of the East, and in many other regions of the world, abhor the folly which they behold in the arrangement of the chronology followed by the Christians in their festivals. At length Christians possess skill in astronomy, by which attestation can be made. Therefore your Reverence has the power to command it, and you will find men who will apply excellent remedies in this particular, and not only so in the aforesaid defects, but in those of the whole calendar. For there are thirteen principal ones with an almost infinite number of branches. If then this glorious work should be performed in your Holiness' time, one of the greatest, best, and finest things ever attempted in the Church of God would be consummated.

Since we have stated how urgently mathematics is needed for philosophy, theology, and the Church of God, we must now show how necessary it is for directing the commonwealth of the faithful. It is important in two principal ways: in one, because of the knowledge it gives us of the future, present, and past; in the other, in useful works. Since the human race is exposed to countless dangers respecting the future, it is very necessary that it have the means of learning the future. Since God has granted man the greater things, namely, soul and body, and promises eternal life, he must not have denied things that are less. For the sun rises upon the wicked and the seas lie open to the pirates. Much more, therefore, will God give to the good a useful knowledge of things, and especially to the multitude, because in it is found the general good. Moreover, since there are always found in the world some good men and pleasing to God, therefore has God given by this means a manifold knowledge of the future, nor can the world stand without it, as Avicenna shows in the fourth book on the Soul, and in the tenth book of the Metaphysics. But the principles concerning the knowledge of the future have been touched upon above in that distinction in which I argued in excuse of mathematics, and showed that a sufficient judgment is possible in all things,

which rests between what is necessary and what is impossible, and between the universal and the particular. For by these means is the human mind illuminated, so that it is able to discourse wisely on all topics and to provide advantageously for itself and for others. I took up later, as the matter required, particular judgments in human affairs, namely, in the distinction on sects. If, moreover, in human affairs and especially in matters of this kind a true and useful judgment may be made, much more can this be done in the things of nature, in a particular as well as proper consideration.

Although in my defense of mathematics, and above in my comparison of celestial forces with those here below, I touched upon the knowledge of the places in the world and of the things generated in them by means of the heavenly bodies, yet now shall I set forth this matter more fully in passing to the art of healing the human body, a knowledge of which is more necessary to man than that of anything else in this world. Not only do I show how we gain knowledge of things in different localities of the world, but also how they are caused in those same places by the different courses of the seasons. But an effect is known only by means of its cause, as all know; but celestial things are the causes of things below, whence these things that are generated must be known through those that are not generated, namely, celestial things. That, moreover, celestial things not only are universal causes, but the proper and particular causes of things below, is proved by Aristotle, who says in the second book on Generation, that the elements are less active than the tools and instruments used in an art are in comparison with the artificer. But the whole action in an art is attributed in the main to the artificer, as, for example, to a builder, not to his tool, as, for example, an axe. Therefore, it is manifest that the principal action of all terrestrial things is attributed to the heavens, since the only agents are the heavens and the elements, which are the instruments of the heavens. Moreover, this is manifest inductively. For in all inanimate things the heavens are the particular cause without contradiction; because inanimate things do not generate anything, nor do they produce individuals of their own species, because a stone does not generate a stone, as a human being does a human being and an ass an ass. It is manifest

then that the force of the heavens incorporate in the matter of the elements produces all inanimate things, and animate things likewise through putrefaction; for in the generation of these things there are only the heavens and the elements. Moreover, Averroës says in the seventh book of the Metaphysics that the force of the sun does the same thing in putrefied matter as the paternal force in the seed, wherefore the heavens are the particular cause up to the generation of things by propagation. But that the same principle holds there, I shall prove. For in the Vegetabilia Aristotle says in the first book on Plants that the sun is the father of plants and the earth the mother; and in the Animalia he maintains this same principle, because in regard to man, concerning whom the principle seems less applicable, he says in the second book of the Physics that man and the sun generate man out of matter, and it is evident that a father does not continue nor terminate generation, but only begins it by letting the seed fall; wherefore of necessity that which continues and perfects generation is the sun or the force of the heavens. Moreover, not only are the heavens the cause in things correctly generated, but also in the faults of nature and in monstrosities. For Avicenna in his eighteenth book on Animals says, "If the embryo is not able to receive human characteristics, it will receive those of an animal, as in the case of monstrosities: for example, when the son of a man has had the head of a ram, and a lamb the head of a bull: since the force in it has produced a form in accordance with celestial shapes, which happen to each one. If, moreover, we proceed further, we are able to investigate the causes of terrestrial things more properly by means of celestial things. But the first principle in this is that every point of the earth is the apex of a pyramid filled with the force of the heavens.

But in addition, that my purpose may be seen more surely and plainly, we must consider what the diversity of the regions of the world is, and how the same region varies in different seasons, and how the different things of the same region receive different qualities at the same time. But these things cannot be known unless we form clear notions of the size and form of the habitable earth and of its climates. But in order that we may obtain such ideas, we must assume that the world is of a spherical form, as we proved above. We shall imagine

three lines drawn from the terminals of the world intersecting each other at the center of the world at right angles, so that one is from right to left in the heavens, and this is due to the fact that it is drawn from east to west through the center of the world; the second up and down, that is from south to north; and this is from the Antarctic pole to the Arctic pole; and the third line forward and backward, that is, from the point in the middle of the heavens above us to the opposite point in the heavens beneath the earth. By a certain transumption in the word it is called the angle of the earth. Thus Aristotle teaches us to imagine six differences of position in the heavens in the second book of the Heavens and the World.

If, therefore, we imagine a circle passing through the east, the middle of the heavens, the west, and the angle of the earth, this circle divides the heavens into two equal parts, leaving one half with respect to one pole and the other half with respect to the other pole, and is called the equinoctial circle, both because the dwellers under it have a perpetual equinox, and for all inhabitants of the earth it is the equinox when the sun comes to that circle and describes it in a natural day. This happens at the beginning of spring and at the beginning of autumn when the sun enters the heads of Aries and Libra. If, now, we imagine another great circle, which crosses through the poles of the world and through the limits of the east and west, intersecting the former circle at right angles, which is called the colure passing through the equinoxes, then will the heavens be divided in four quarters, two of which will be above the earth in one location and the other two beneath the earth. One fourth to the north will be above us, namely, the fourth contained between half of the equinoctial circle and two quarters of the colure mentioned, terminated at the Arctic pole in one direction and at the points of east and west on the equinoctial circle, as is shown in the figure, and this is the fourth part above. In a similar manner we must imagine that the earth is spherical, and those aforesaid three lines will pass through the center of the earth, intersecting one another at this point at right angles; for they are perpendicular to the earth, and since at their intersection the center of the heavens and of the whole world is located, of necessity the same point is the center of the world and of the earth; because that intersection is only at one point by the fifth

proposition of the first book of Theodosius on Spheres. For if a straight line falls perpendicularly from the heavens to a plane surface tangent to the sphere of the earth, the center of the earth will be on that line by the fifth proposition, which says, if a plane is tangent to a sphere, and from the point of contact a straight line is drawn perpendicular to the tangent plane, the center of the sphere must be on this same line; but that same line will be perpendicular to the plane tangent to the sphere of the heavens, therefore on that line will be the center of the heavens, and this line is one of the three mentioned. Similarly each of the others, by the same reasoning, will pass through the center of the heavens and the center of the earth; but any one of these lines intersects another only in one point, therefore at that same point there will be the center of the heavens together with the center of the earth, and for this reason the earth lies at the center of the world. Therefore if we imagine two circles on the earth corresponding to those described in the heavens, one beneath the equinoctial circle passing through the east and west and the point on the earth beneath the point in the middle of the heavens; and the other through the east and west points and the points on the earth corresponding to the poles; then by these circles will the earth be divided into four quarters, of which two will be on the surface of the earth in our location; and the other two in the other direction of the earth. One will be to the north, namely, from the middle of the earth under the equinoctial circle up to the point of the earth beneath the Arctic pole contained below the lines which run from the east and from the west to the pole or to the point of the earth situated under the pole. This is the fourth part, about which we are inquiring, in which the habitation is known, and it is located beneath the quarter of the heavens noted above.

Now the subject of habitation is considered in two ways; in the first, with respect to the heavens, namely, how much can be inhabited on account of the sun and how much not. This question was mentioned previously in a general way, and will be touched upon later. In the second way, the size of the habitable earth in comparison with the water is considered, namely, how far the water hinders. We are now to consider this latter question. Ptolemy in his book on the Arrangement of the Sphere maintains that about a sixth part of the earth is habitable, due

to the water, and that all the rest is covered by water. Therefore in the Almagest in the second book he states that habitation is not known except in a quarter of the earth, namely, in that in which we dwell; whose length is from east to west and is one half of the equinoctial circle; and its width is from the equinoctial circle to the pole, and is one fourth of the colure. But Aristotle maintains at the end of the second book of the Heavens and the World that more than a fourth is inhabited. And Averroës confirms this. Aristotle says that the sea is small between the end of Spain on the west and the beginning of India on the east. Seneca in the fifth book on Natural History says that this sea is navigable in a very few days if the wind is favorable. And Pliny teaches in his Natural History that it was navigated from the Arabic Gulf to Cadiz; whence he states a man fled from his king in fear and entered a gulf of the Red Sea which is called Arabic, which is distant about the space of a year's voyage from the Indian Sea according to Jerome in his letter, as will be explained below. Therefore the width of the earth through which the Red Sea extends is very great; from which fact it is clear that the beginning of India in the east is far distant from us and from Spain, since the distance is so great from the beginning of Arabia toward India. From the end of Spain beneath the earth the sea is so small that it cannot cover three quarters of the earth.

This fact is proved by the weight of another consideration. For Ezra states in the fourth book that six parts of the earth are habitable and the seventh is covered by waters. That no one may lessen this authority by saying that that book is apocryphal and of unknown authority, we must state that the sacred writers have used that book and confirm sacred truths by its means. Many times in the divine Office they use authorities from that book. Therefore, whether Ezra or another composed this book, it must be taken as an authority. Wherefore I say that although the habitable portion known to Ptolemy and his followers is reduced to less than a quarter, yet the habitable portion is more. And Aristotle was able to know more, because on the authority of Alexander he sent two thousand men to investigate the things of this world, as Pliny states in the eighth book of the Natural History. Alexander himself journeyed as far as the boundary of the east, and as is clear from the History of

Alexander and from the letters which he wrote to Aristotle, he always sent him word about all the wonderful and unusual things he found in the East. Therefore Aristotle could attest more than Ptolemy could. And Seneca likewise; because the Emperor Nero, his pupil, in similar fashion sent him to explore the doubtful things in this world, as Seneca states in the Questions on Nature. Therefore according to these facts the extent of the habitable portion is great and what is covered by water must be small. For toward the poles of the world the water must abound, because those parts are cold, owing to their distance, but cold multiplies moisture, and therefore from pole to pole the water runs down into the body of the sea and extends for no great width between the end of Spain and the beginning of India, and is called the ocean; so that the beginning of India can be far beyond half of the equinoctial circle beneath the earth quite close to the boundary of Spain. But that the truth in this matter may not be condemned as false, we must know that Spain in this locality is considered not as hither but as farther Spain, of which certain authors speak, as Pliny in the Questions on Nature, and Merlinus in his prophecy, and Orosius in his book Ormesta Mundi, and Isidore in the fourteenth book of the Etymologies. Since he teaches that between the Spain so called at present and the Africa so named at this time water did not flow, but the land was continuous in times past, but later the ocean broke through in the low parts of the earth and joined the Tyrrhenian Sea, which flows by the coast of the province of Arragone and of Italy. Therefore Hither Spain extends from the Pyrenees Mountains to Carthage: but Farther Spain crosses the Strait of Gibraltar up to the provinces of Africa. Hence it extends beyond Gibraltar and reaches the Atlas range. I have cited these statements from the authors mentioned, of necessity, in order that Aristotle and his commentator should not be derided through ignorance of Farther Spain, when they state as a proof of the smallness of the sea between Spain and India that elephants are found only in those two places. For it is a fact that elephants abound near the Atlas range, as Pliny states, likewise Aristotle, so too in India, and therefore in Farther Spain there is an abundance of elephants; but Aristotle says that there cannot be elephants in those places unless they are of a similar character, and if the distance were

great they would not be of similar characer, and therefore elephants would not be in those places only. Wherefore he concludes that these places are nearer, and that the sea for this reason must be small between them.

The sea will not therefore cover three quarters of the earth, as is estimated. For let the upper half of the earth be *abcd,* in one quarter of which, namely, *abc,* is the habitable portion known to us. It is now clear that much of that fourth will be beneath our habitable portion, because the beginning of the east and the beginning of the west are near, since a small sea separates them from the other part of the earth. Therefore the habitable portion between east and west will not be half of the equinoctial circle, nor half of the circumference of the earth, nor twelve hours, as is estimated, but much more than half of the circumference of the earth, and more than the revolution of one half of the heavens. But how much this may be has not been measured in our times, nor have we found it attested, as it should be, in the books of the ancients; nor is this strange, since more than half of the quarter in which we are is unknown to us; nor have the states been included by the philosophers, as will appear from what follows. Similarly, if we speak about the two other quarters, and consider natural processes in accordance with natural philosophy, we shall find that those quarters are not covered by water, as the majority of mathematicians estimate. For since the poles and the regions near them are of the same remoteness from the sun and the planets in accordance with the relative position of the poles to the paths of the planets at the middle of the world, between the two tropics, there must, in accordance with these facts, be equal dispositions of land and water in our quarter and in the quarter beyond the equinoctial circle toward the other pole; and likewise in the fourth under our feet up to the equinoctial circle: and in the fourth beyond the equinoctial circle there will be a similar arrangement according to the tenor of the preceding statements. Therefore if our quarter is not covered by waters at least up to the latitude and distance from the equinoctial circle of 66 degrees, as at the end of the islands of Scotland

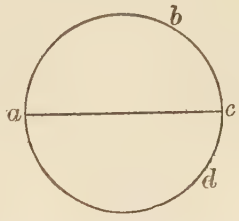


FIG. 22.

and in the kingdom of Norway, it is manifest that a similar natural cause will exist in the other quarter beyond the equinoctial circle in the upper part of the earth as in the one in which we are, because remoteness from the path of the sun induces cold, and cold multiplies moisture, and for this reason about the poles there will be a natural gathering together of waters, and in the regions that are near. Therefore in the other quarter beyond the equinoctial circle there must accordingly be much that is habitable; at least as far as the regions whose latitudes reach 66 degrees, just as is the case here.

But according to mathematicians a larger habitable portion can be assumed there than in our quarter due to the lack of water, since in that part is the point opposite to the aux of the sun, and the sun draws much nearer there to the earth. Whence it must necessarily parch that quarter in some portion of it, and render the remaining portions as far as the pole hotter than the portions of our quarter in which we dwell. We can argue in a similar way in regard to the remaining quarter under that one. And again, Aristotle in the first book of the Heavens and the World and Averroës are cited in support of the view that the remaining half of the earth beyond the equinoctial circle is a locality elevated in the world and nobler and for this reason most fitted for habitation. Wherefore it will happen according to the arrangement of nature that hindrances to habitation are to a greater degree excluded, at least in a large part of that half, namely, in that portion further removed from the point opposite the aux of the sun, if we assume an eccentricity, and everywhere if an eccentricity be not assumed, and this fact is due to nobler stars in that part, as Averroës maintains in the first book of the Heavens and the World. Moreover, Ptolemy states in his book on the Arrangement of the Sphere that nature requires that there should be two races of Ethiopians, namely, under the two tropics. From which some argue that there is habitation beyond the equinoctial circle just as there is this side of it; and according to these views the habitable portion will not have the shape of a quarter of the sphere nor of a semicircle drawn in a plain, nor will the water encompass the world through the poles and the east and west covering three quarters of it, as is believed; but rather will the form of the water be of this kind or similar to it, so that this sea may be called ocean,

having most of its water about the poles, extending in length from pole to pole between the beginning of India and the end of Spain, which is known to the mathematicians.

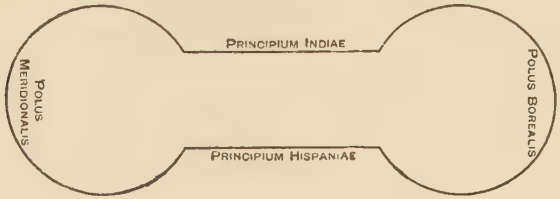


FIG. 23.

Since the habitable portion is known to mathematicians only in the quarter in which we are, and also the whole quarter is unknown which is contained within half of the equinoctial circle and half of the colure crossing through the poles and the extremities of the equinoctial circle beneath this figure, therefore, in discussing the opinion of the mathematicians we must omit what is uncertain and consider that which is known to the great philosophers. Among all since the Incarnation of our Lord has Ptolemy given the most accurate information in this particular, and has in the second book of the Almagest defined that quarter in which we are. His division and that of Alfraganus and of others is better known by means of the seven famous climates. Climate with them is the space of the earth in which the longest day exceeds by half an hour the longest day of the second division of the earth or is exceeded by the same. It is certain, however, that a more natural and truer distinction would be according to the quarter hour, as Ptolemy at first made the divisions; but because those parts are small, the greater philosophers have united two of them together and consider them as one climate. Since these climates and the famous cities in them cannot be clearly understood by means of mere words, our sense must be aided by a figure. In the first place, then, I shall give a drawing of this quarter with its climates, and I shall mark the famous cities in their localities by their distance from the equinoctial circle, which is called the latitude of the city or region; and by the distance from the west or east, which is called the longitude of the region. In

the divisions of the climates and in the latitudes and longitudes of cities I shall follow the authority and experience of learned men. But in marking the position of a city by means of its longitude and latitude found from the authorities on this subject, I shall give an additional device by which the position of the state may be known by its distance from south, north, east, and west. This device consists in intersecting a straight line parallel to the equinoctial circle, marked on a plain and coinciding with a straight line drawn from the number of the degrees of the region marked on the fourth of the colure drawn from the equinoctial circle to the pole of the world—consists, I say, in the intersecting of such a line with the arc of a great circle passing through the poles of the world and through the number of the longitude of the city marked on the equinoctial circle. This is a better and easier method and suffices for a study of the places in the world in a drawing of this kind which appeals to the sense.

I shall also show, together with the latitude of each climate, how many miles each one contains, how many degrees in the heavens correspond to each and how many hours the longest day contains. Moreover, the elevation of the pole above the horizon in each climate is its latitude from the equinoctial circle, and the zenith distance from the equinoctial circle is the same as the latitude and the elevation of the pole; and I give the number of miles of the whole space of the seven climates. But although the philosophers note only seven climates, they nevertheless mark the other spaces of the earth both before the climates and after them. For Ptolemy says in his book on the Arrangement of the Sphere that a journey was made with the help of the kings of Egypt as far as the equinoctial circle. By few men, however, and rarely, has this space before the climates been crossed, owing to its distance, but still more to the negligence of princes who should have aided philosophers in this matter. I mark, then, three spaces before the known climates, which contain more of the earth's surface than a single climate, and I give the number of miles in the width of that space between the equinoctial circle and the first climate, and I state how many miles there are from the equinoctial circle to the end of the seventh climate; then I divide the space which is beyond the climates. Ptolemy in the seventh book of the Almagest dis-

tinguishes that space by adding the excess of a quarter hour beyond the length of the day in the preceding region up to the point where he reaches the latitude of the region which is 61 degrees. After that he proceeds by the half-hour period up to the latitude of 64 degrees; and from that location he divides the spaces by one hour up to the latitude of 66 degrees, where the night is continuous at the winter solstice, except that half of the sun comes suddenly to the horizon, and the day is continuous at the summer solstice, and this is far beyond Scotland. Then the sun is always visible in the north toward the pole.

But the space beyond is then divided notably by the length of a day of one month, or of two, three, four, five, or six. For dwellers beneath the pole have day for half the year, that is, they have the sun above the horizon for six months and below the horizon for the other six; but the evening twilight lasts for seven weeks and one day, namely, from the sixteenth day of September inclusively, on which the sun enters at the present time the sign of Libra up to the sixth day of November exclusively. For so long a period does the brightness of the sun continue above the earth, just as with us in the summer after sunset; because on that sixth day the declination of the sun beneath the horizon is 18 degrees and 6 minutes; and twilight lasts up to the end of the 18 degrees and no more. From that same sixth day of November inclusively up to the twenty-first day of January inclusively there is dark night for ten weeks and five days. For on that twenty-first day the sun is beneath the horizon 18 degrees and 6 minutes, and therefore morning twilight cannot begin on that day, but the sun must first pass through those six minutes. But from that day, namely, from the twenty-first of January exclusively, the dawn begins, and lasts up to the entrance of the sun into the sign Aries, which happens on the thirteenth day of March at the present time, and lasts for seven weeks and one day. For the remainder of the time while the sun advances from the first degree of Aries to the first degree of Libra, the sun is always above their horizon, that is, for half a year; because their horizon is the equinoctial circle. Therefore the six northern signs are always above the horizon, as is apparent sensibly on the sphere. Therefore while the sun is in those signs they have clear day. Nevertheless the two twilights, in which the brightness of the sun appears above

the horizon, taken together continue for three months, two weeks, and two days, and therefore in comparison with the twilights and the day the dwellers in that locality under the pole have little night throughout the year.

All these things I have written, following principally Ptolemy and Alfraganus, and the table of longitudes and latitudes of states. For in the latitudes of the climates and of the spaces before and after the climates I have followed the view of Ptolemy in the Almagest. But Alfraganus has been my chief authority in what I have written in regard to the extent in miles of the climates and of the spaces before and after the climates, and in regard to the states and regions contained in those climates and spaces, with these exceptions, that the computations of which he does not treat in exact terms I present by means of a fuller examination; and in following other authors I sometimes make a change and an addition, as the need arises for greater certainty; as in the case of the city of Syene.

But if it be objected that in the canons of astronomy and in the tables the longitudes and latitudes of cities are found to be different, as is clearly evident concerning Toledo, for the meridian of which the Toledo tables are made, we must say that first in one way and then in another do they understand the east and the west. For the east and the west of which we are speaking here are the remotest points of the habitable earth. But in one way east and west are understood as points beneath the equinoctial circle at the middle of the earth; so that the beginning of India beneath the equinoctial circle is the east of the habitable earth; and the boundary of Farther Spain, if it extended to the equinoctial circle, would be the west; but it does not extend so far, nay, there is a great stretch of country from the southern part of Farther Spain to the equinoctial circle. The boundary therefore of that stretch westward is the west of the habitable earth. But since the earth westward may have great breadth, namely, from the equinoctial circle as far as the Atlas range and Gibraltar, and on this side through the whole circuit of all Spain and Ireland, the term west can be understood by different people in different ways; whence some understand it from Cadiz, some from the Atlas range, some from the boundary of the habitable world on the equinoctial circle. But when it is taken on the equinoctial

circle it is defined better, because it is a single method and a better one, since this point is in the middle of the world between the two poles, and therefore is the true west; and the same is true of the east. But the table of latitudes and longitudes does not take longitudes from the west on the equinoctial circle, as we know. For reckoned thus the longitude of Toledo is 29 degrees west, and according to the table it is only 11. The author of that table took the west known to him and fixed, and with respect to the situation of his own region. We must here consider, however, that the division of the earth cannot and must not be taken in any other way than with respect to the farthest points of the earth, where the sea called ocean ends, which lies between India and Farther Spain and the other regions west and east that follow India and Spain. Whence these terms must not be understood as referring to the limits of some horizon in the way in which we speak sometimes of east and west with reference to the rising and setting of the sun. For there are an infinite number of horizons, both inclined and straight. Therefore east and west in the division of the earth are not taken with reference to the horizon: for then would the east of one horizon be the west of another horizon and the middle of it.

We must note that the true west and east are on the equinoctial circle, as has been said; the remotest habitable point of Farther Spain is considered the west and the remotest point of Farther India as the east. If, therefore, we wish to take the distance of a city from the west as now stated we shall draw a line from this west point parallel to the city, and the line intercepted between the city and the parallel mentioned will denote its longitude westward. Similarly let a line be drawn from Arym, a city at the middle of the world, to the Arctic pole, and from this line let a straight line be drawn to the other city. This line will mark the distance from the middle of the world. But sometimes distance is taken from the west with respect to the boundary of the habitable earth in a straight line with that city; and because this varies in infinite ways among different inhabitants, the taking of longitudes varies. But it is better to take it from the west on the equinoctial circle, because this is done in only one way. Moreover, because the longitude from Toledo and the latitudes of other cities are found collected only in this table, I have for this reason followed it in this particular,

although greater accuracy is required, since the longitudes and latitudes of cities and regions have not yet been attested among the Latins; nor will they ever be attested except by apostolic or imperial authority or through the aid of some great king who will furnish the means to men of science. In accordance, then, with the statements made I am offering the present description on the whiter part of the parchment, where the cities are marked by red circles: for in another part of the parchment it will be possible to give another description for greater clarity with respect to the places in the world. This second description I am adding on account of the very great importance of the places. Since, then, there is a very great advantage in knowing the places in the world, the other description must be presented. For the things of the world cannot be known except through a knowledge of the places in which they are contained. For place is the beginning of the generation of things, as Porphyry says; because in accordance with the diversity of places is the diversity of things; and not only is this true in the things of nature, but in those of morals and of the sciences, as we see in the case of men that they have different manners according to the diversity of regions and busy themselves in different arts and sciences. Since then philosophy introduces itself to the things of the world, there is much still lacking in it among the Latins, because it does not possess attestation respecting the places in the world. But this attestation consists in a knowledge of the longitude and latitude of every place; for we should then know under what stars each place is, and how far it is from the path of the sun and the planets, and from what planets and signs places receive their control, all of which things cause the different characteristics of places. If these things were known, man would be able to know the characteristics of all things in the world and their natures and qualities which they contract from the force of their location.

Not only philosophy requires this, but also theology, of which the whole sequence deals with places in the world. Whence the literal sense rests on a knowledge of the places in the world, so that by means of suitable adaptations and similitudes taken from things the spiritual meanings may be elicited. For this is the proper way to expound Scripture, as I have shown above in the example. This knowledge of the places in the world is very

necessary to the state of the believers, and for the conversion of unbelievers and for opposing unbelievers and Antichrist and others. For because of different advantages to the state and because of the preaching of the faith men are sent to the different places in the world, occupations in which it is very necessary for those setting forth to know the characteristics of foreign places, so that they may know how to choose temperate places through which to pass. For the most vigorous men sometimes through their ignorance of the places in the world have destroyed themselves and the business interests of Christians, because they have passed through places too hot in the hot seasons or too cold in the cold seasons. They have also met with countless dangers, because they did not know when they entered the regions of believers, or of schismatics, Saracens, Tartars, tyrants, of men of peace, barbarians, or of men with reasonable minds. He who is ignorant of the places in the world lacks a knowledge not only of his destination, but of the course to pursue. Therefore whether one sets forth to convert unbelievers or on other matters of the Church, he should know the rites and conditions of all nations, in order that with definite aim he may seek the proper place; lest, if he should wish to visit pagans he fall among idolaters, or if he has those as his goal, he invade schismatics, or pick out as schismatics those obedient to the Roman Church, or those indifferent to both sides, of which kind are the tribes who are called Aas; in order also that he may avoid Nestorians when he wishes to reach Nicolaitans; and so among the many races of divers sects he may not choose one instead of another through error. For very many have been foiled in the most important interests of Christian people because they were ignorant of the distinctions in regions.

Moreover, no small necessity of knowing the places in the world arises from the fact that the Church should have excellent knowledge of the situation and condition of the ten tribes of the Jews, who will come forth in the days to come. For Orosius in his work, Ormesta Mundi, addressed to Augustine, says in the third book that Ochus, who is Artaxerxes, compelled very many of the Jews to emigrate, and directed them to dwell in Hyrcania on the Caspian Sea. It is the opinion that these tribes exist up to the present day with great increase in their numbers

and that some time or other will burst forth from that region. The Master in the Histories adds that Alexander the Great found them confined there, and because of their wickedness restrained them more narrowly, who, however, according to his testimony, will come forth near the end of the world and will cause a great massacre of the people. Moreover, in his Cosmography Ethicus the astronomer says that various races must come forth around the days of Antichrist, and they will call him God of Gods who is destined to lay waste the regions of the world. Jerome, moreover, confirms this in the book which he translated on the wise sayings of this philosopher.

Moreover, Alexander the Great fought with these nations, but could not conquer them, as this same Ethicus testifies and Jerome recounts, and therefore he lamented and said, "Nations composed of reasonable and wise people have I destroyed, and I have overthrown a famous and noble people and an honest race. Of what advantage or necessity was it, when we have left here hiding in the human species all the demons of hell and phalanxes of adversaries? Oh, that they may never hear or learn of the earth flowing with honey and of the very great glory of the world, lest perchance they rush forth over the whole surface of the earth and snatch away and devour all like bread. O earth, mother of dragons, nurse of scorpions, pit of serpents, den of demons, it had been better for hell to be in thee than to give birth to such races. Woe to fruit-bearing and honey-flowing earth when so many serpents and beasts shall rush forth into it. Woe to the inhabitants of the world, when those races begin to triumph. If Alexander had not taken measures effective for the time being against these tribes, no race could have endured their oppression." So writes Jerome. Since, then, these nations shut up in certain localities of the world will come forth to desolate regions and meet Antichrist, Christians and especially the Roman Church should study carefully the location of places, that it may be able to learn the ferocity of nations of this kind and through them to learn the time and origin of Antichrist; for these races must obey him. Therefore if they come from one part of the world, he will come from that opposite, when, however, the bars of Alexander have been broken. For some were shattered before Isidore, since he writes about them. Friar William, moreover, whom the lord king of

France sent to the Tartars in the year of our Lord 1253, when he was beyond sea, wrote to the king aforesaid that he crossed with Tartars through the middle of the gates that Alexander constructed. For when he was not able to conquer these races, then, as Ethicus writes and Jerome confirms, Alexander offered victims to God, and prayed a whole night and day for God's mercy and counsel, and by the divine power a great earthquake happened, and opposing mountains came together and approached through the distance of a stadium, so that space was left only for a single chariot, and he himself then erected gates of wonderful size and smeared them with an unknown cement, which can be dissolved neither by fire nor iron nor water nor by anything else except a severe earthquake.

Since, then, there is a boundless advantage in a knowledge of the places in the world for philosophy, theology, and the Church of God, I wish to compose still another dissertation on places of this kind and to assign more clearly the divisions of the regions; and I shall follow Pliny rather copiously, whom all the sacred writers and men of science have followed. But when I shall have discovered anything definite through other authors, both the sacred ones, as Jerome, Orosius, and Isidore, and through others, I shall not neglect to give those facts that are necessary. But the particular divisions of the regions known to us it is unnecessary to note, likewise the individual places in other regions, but rather those more notable and famous in Scripture and philosophy; from which tyrannical nations will come and have come that are reported from the past to have ravaged the world or as destined to do so at some time. I shall state the rites and sects of the races, for example of those who are pagans, idolaters, or Tartars, and so concerning others, that a clearer understanding of places may be in the mind of the reader. This path by which I shall proceed is not that of astronomical attestation, namely, by the true longitudes and latitudes of places with respect to the heavens, because the Latins do not have this knowledge as yet; but the information is derived from authors who describe the regions of the world according to the ability of each to describe the places of his native soil and to be instructed by others concerning foreign parts.

Sometimes, however, many things are found written which

authors have gathered from reports more than from experience. For Pliny was not accurate in saying that the Caspian Sea rises from the ocean, and Ptolemy was plainly in error regarding the location of Greater and Lesser Britain, as is manifest to everybody, and so are those authors in error in regard to many other matters, and other authors likewise. Wherefore I shall have recourse to those who have in great measure traveled over the places of this world. Especially in the northern regions I shall follow the friar mentioned above, whom the lord king of France, Louis, sent to the Tartars in the year of our Lord 1253, who traversed the regions of the East and of the North, and wrote these facts to the aforesaid illustrious king. I have examined this book with care, and I have conferred with its author, and likewise with many others who have explored the places of the East and South. Yet just as I composed the former description rather to serve as a model and an inspiration to your Glory, that it might be completed at the proper time by the scientific men of this world, rather than as an attestation, so also am I writing this division, that your Wisdom may recognize that greater labor is here needed than the present plea ought to contain. For the perfected treatise you require must complete both descriptions.

Now in setting forth the views of writers on nature and of experimenters and of the sacred writers regarding the habitable parts of the world we must not confine ourselves to those facts which mathematicians among the Latins have attested, for such facts are few; but going more broadly afield, supported by authority and manifold experience, we state that not only are the seven climates inhabited, but a fourth of the earth, and much more than a fourth, contains nations of men. For we find in Pliny and in others that there are certain localities in our habitable portion that are called *ascia,* that is without shadow, from *a* meaning without, and *scia,* shadow, and these places vary in many ways. For in some places things do not have a shadow north or south at the summer solstice. For when the sun is over their heads at noon, there is no shadow to the north or south, nor to the east or west, and this happens on an island of the Nile which is called Syene, in the remotest part of Egypt at its boundary and that of Ethiopia, as is manifest from Pliny in the second and in the fifth book; and Lucan says, "Syene

THE KNOWN WORLD IN

From the Berlinghieri Paraphras

E MIDDLE AGES

Ptolemy's *Geographia*

nowhere casting shadows"; that is, at noon of the summer solstice, and this happens toward the boundary of the second climate, of which mention is made many times in Ezekiel. Other places are called *ascia,* because twice a year they do not have shadow. For certain places in our summer cast a shadow to the south when they have the sun to the north. In our winter they make a shadow to the north since the sun is in the south, according to Pliny in the second book; and alternation of shadow is through six months, as Pliny states in the sixth book, chapter XIX. This cannot be except on the equinoctial circle, since although those who dwell between the tropic of Cancer and the equinoctial circle have a manifold variety in casting shadows, now to the north, now to the south, yet they cannot have this variety through six months, but they will cast the shadow more to the north than to the south, because they have the sun more to the south than to the north. But those who are on the equinoctial circle have the sun equally to the north and to the south, namely, both for six months. This race in India is called the Orestes and the Monedes and the Simari, among whom there is a mountain, Malcus by name, on which shadows thus vary for six months, as Pliny states in the second and in the fifth book. But what is more, we discover through him that there is habitation on the tropic of Capricorn or beyond it. For a region in India is called Pathalis with a very noted port, as he says, where the shadows fall only in the south; therefore dwellers here have the sun always to the north. He states the same thing in the sixth book respecting the island of Taprobane in India, from which men coming to Rome in the reign of Claudius were surprised that their shadows fell to the north and that the sun rose from the south; and therefore among these people shadows fall always to the south and the sun always rises to the north.

Therefore the statement of Ptolemy in his book on the Arrangement of the Sphere is correct, that nature requires that there be two races of Ethiopians on the two tropics. But if the sun has eccentricity, then although as far as the natural arrangement of the heavens is concerned a place on the surface of the earth will be uninhabitable owing to the heat when the sun comes to Sagittarius and Capricorn, because of his nearness to the earth and on account of the uniting of the parallels

and on account of the falling of the rays at right angles; and it will be uninhabitable owing to the cold when the sun is in Gemini and in Cancer, because the sun then recedes too far from them, and his rays fall at oblique angles; yet owing to other accidental configurations of the localities, because of the height of mountains keeping off the heat of the sun, and for other reasons, some places there can be habitable, and especially in places beneath the earth when the sun is near the point opposite to the aux. Elsewhere there may be a plain of such a kind between these mountains and the sun, and behind it mountains formed like concave burning mirrors of such smoothness that it is possible for the localities to be habitable when the sun is at the aux without hindrance from the cold, just as I stated above in regard to the localities about the poles of the world. But if we assume the circle of the sun as concentric together with an epicycle, as is possible, just as Ptolemy says in the Almagest, then habitation in that locality can easily be maintained, because in that case the sun does not approach so near to the earth as wholly to consume that part beneath the winter tropic, nor does it depart so far from it as to abandon it in the cold. But if we assume neither an epicycle nor an eccentric circle, according to the view of the writers on nature, there follows no difficulty in the matter of habitation. Therefore whatever opinion we hold in this matter, Pliny can be sustained. And of necessity so, since he learned the certainty of the fact from experience in the case at least of those who came to Rome from Taprobane and of those who were conducted to the island. But although the locality beyond the tropic of Capricorn forms an excellent habitation, because it is the upper part in the world and nobler according to Aristotle and Averroës in the first book of the Heavens and the World, yet we do not find in any author that land described, nor the inhabitants of those localities named, nor the information given that they visited us nor we them. Therefore it is the opinion of some that paradise is located there, since it is the noblest place in this world, according to Aristotle and Averroës in the second book of the Heavens and the World. But not only the philosophers, but also the sacred writers, like Ambrose in the Hexaemeron and Basil, agree in the matter of this diversity of shadows. For in the fourth book Ambrose says, "There are those who through two whole days of

the year are without shadow in southern parts, because having the sun above their heads they are illuminated on all sides; whence they are called *ascii,* that is, without shadow; and *amphiscii,* that is, shaded round about: These people dwell on the equinoctial circle and about it on either side, who when the sun is not above their heads cast sometimes the shadow to the north, sometimes to the south, according to the sun's position now to the north of them and now to the south." He adds, moreover, "There are people located to the south in this world we inhabit who are seen to cast their shadow to the south." Because he speaks expressly of shadows to the south, he can be understood to have reference to those who have shadows falling to the south only, namely, dwellers on the tropic of Capricorn and beyond it; because the sun is always north of them except at one time when it is over their heads on the tropic of Capricorn.

How far habitation extends north Pliny shows through actual experience and by various authors. For habitation continues up to that locality where the poles are located; and where the day lasts six months and the night for the same length of time. Martian, moreover, in his description of the world, agrees with this statement; whence they maintain that in those regions dwells a very happy race, which dies only from satiety of life, attaining which it casts itself from a lofty rock into the sea. These people are called Hyperboreans on the European side and Arumphei in Asia. These statements have been made, therefore, according to the latitude of the regions which is on this side or on the other of the equinoctial circle, in order that we may see that the inhabited portion of the earth exceeds a quarter according to the latitude of the regions.

This fact can in like manner be made apparent regarding longitude, which is reckoned from east to west. For as Pliny in the sixth book of his Natural History writes, "India alone is a third part of the habitable earth." Jerome, moreover, says to the monk Rusticus, "Those navigating the Red Sea with many difficulties and dangers arrive at a very great city. The voyage is a lucky one if they reach after six months the port of the aforesaid city, from which the ocean begins to open, through which scarcely at the end of a whole year does one arrive at India." Therefore from the port on the Red Sea toward us a voyage of a year and a half is required to reach India. Jerome

states in his book on places that the fleet of Solomon for the space of three years carried wares from India, so that the voyage thither required a year and a half, and the return voyage the same time. But the distance of the Red Sea to the end of Farther Spain about the Atlas range is immense. It is manifest, therefore, that from the limit of the west to the end of India above the earth will be much more than half of the earth: so that of necessity we adopt the opinion of Ezra, Aristotle, and Averroës, which was discussed above in regard to the size of the habitable portion of the world between the east and the west, which exceeds a quarter of the earth according to longitude. When Pliny says that Europe is larger than Asia, he does not include in this division India owing to its size, since it is a third part of the habitable earth according to him, as has been stated.

Since we have considered the facts with reference to the size of the habitable earth as a whole, it is now worth our while to take note of some more famous parts in Scripture and in philosophy, about which it is useful for Christians to know for the conversion of unbelievers, and because of diverse affairs to be transacted with the different races, and because of the advantages to the Church against the rage of Antichrist and of those who are believed to precede his times, in order that they may lay waste the world first until the very great tribulation comes through Antichrist. And here not only is there necessary a depicting and a representation of the places, but also a narrative of those things which must be depicted; for neither suffices. I shall follow authors and investigators with such diligence as I can as far as suffices at present until complete information respecting places is required. I shall begin with the parts to the south and to the east, particularly on account of Scripture, which is more concerned with those localities. I say, then, in accordance with the former statements that the southern frontier of India reaches the tropic of Capricorn near the region of Patale and the neighboring lands which are washed by a great arm of the sea flowing from the ocean which is between India and Farther Spain or Africa, concerning which Aristotle was quoted above. For Pliny expressly states that the sea touches the southern part of India, and this fact is confirmed by Jerome and Alfraganus. That sea stretches along the southern coast of

India and extends for a distance equal to a year's voyage until it joins the Red Sea, as is clear from Jerome, Pliny, and others; and in that sea to the east with respect to India is the island of Taprobane distant across the Sea of Nadosius a voyage of seven days. On this island the Great Bear and the Pleiades are not visible. The inhabitants have gold, silver, and precious stones in abundance, and their resources are greater than those of Rome. But the Romans make a greater use of their wealth, as Pliny states. They choose as king an old man of a mild disposition and childless: but if he has sons later, the royal power does not pass to them. To the king are given thirty governors, whose advice he follows in governing the people. If he is guilty of a crime he is condemned to death. The sentence, however, is carried out in such a way that no one lays hands on him; but food and all other things are denied him, also no one talks with him, whence his death is due to himself. Human life among them is counted short at a hundred years.

The southern coast of India passes from the tropic of Capricorn and cuts the equinoctial circle near the Malcus range and the regions conterminous with it, and passes through Syene, which is now called Arym. For in the book on the Courses of the Planets it is stated that there are two Syenes; one beneath the solstice, of which I spoke above, the other on the equinoctial circle, of which I am now speaking, distant 90 degrees from the west, but more from the east, because the longitude of the inhabited earth is more than half of the heavens or of the earth. This is true eastward. Therefore Arym is not distant from the east only 90 degrees. But mathematicians assume that it is in the middle of the inhabited earth on the equinoctial circle equally distant from the west and east, north and south. Nor is there a contradiction, because mathematicians speak of the habitable earth known to them according to the true conception of longitudes and latitudes of the regions; and this is only so far as is known through experience derived from journeys by land and sea, as given in Pliny and other writers on nature. According to the information given by authors, and especially by Pliny, the Indian Sea, passing along the coast of India from the tropic of Capricorn and cutting the equinoctial circle, crosses the southern coast of India; then embracing an immense space of the earth turns west by south, until it takes in the straits

and mouth of the Red Sea, and continues southward beyond the southern boundary of Aethiopia to the sea in the west.

Between the straits of the Red Sea and the Sea of Aethiopia, Aethiopia begins. Where the latitude of the region is about 16 degrees, and the length of the longest day about thirteen hours according to Ptolemy in the Almagest—Pliny also is in practical agreement in his sixth book and in his second book—is Saba, an island formed by the Nile, the royal city of Aethiopia, concerning which we read in Isaiah "the labor of Egypt, the traffic of Aethiopia and of Saba," in regard to which in the thirteenth book Jerome says that it is the Sabaean tribe which is across Aethiopia. This is Meroë, which is at the remotest point in Aethiopia and at the end of the known habitable portion of the earth, as was before stated, and it is mentioned in Ezekiel XXVII, which Josephus in the first book of the Antiquities states was given the cognomen Meroë by King Cambyses from the name of his sister, and Jerome is witness to this fact in his book on Places. This city is distant from the Sea of Aethiopia about 700 miles according to Pliny in the sixth book. This city is on the first climate, from which the climate receives the name Diameroës [through Meroë]. Candar, a woman, was ruler there, whence the name of Candax for many years now has passed to the queen, as Pliny states, and he infers that when the Aethiopians were in control of affairs this city was of great renown. They state that it was accustomed to furnish 250,000 armed men and support 400,000 artificers. Moreover, the Acts of the Apostles make mention of a eunuch of Candace, queen of the Aethiopians, whom Philip baptized; whence Candax is a name of rank, like Caesar, Ptolemy, Pharaoh, Antiochus, and Abimelech. For the Abimelechs among the Philistines, the Antiochi in Syria, the Ptolemies in Egypt after the death of Alexander, and the Pharaohs in the same country in ancient times were like the Caesars and the Augusti in the Roman empire, as Jerome states in the ninth book on Ezekiel. But where the latitude of the region is about the same on the shore of the Red Sea is the city of Ptolemais, founded by Ptolemaeus Philadelphus for the earliest hunting of elephants, where for about forty-five days before the solstice and for as many after it there are no shadows at noon, and in those ninety days or thereabouts the shadow falls to the south, because the sun is to the north,

and after these days the shadow falls for the rest of the year to the north. Men dwell here beneath the circuit of the half of Taurus and the half of Leo. Whence the sun crosses twice a year over their heads in those halves of the signs.

Then beyond, in the same latitude but toward the west, between Ptolemais and Meroë 4820 stadia distant from Ptolemais, as Pliny states and Bede confirms in his book on Chronologies, is Berenice, the city of the Aethiopian Troglodytes, where the sun passes similarly twice a year, and the shadows are like those in Ptolemais. For the region of the Troglodytes must bend in part to the west, as will be explained below. It will not, therefore, be in eastern Aethiopia, but more in the central part. Moreover, Scripture mentions these Troglodytes in the second book of the Apocrypha in the twelfth chapter, who came with Selsac, king of Egypt, as an aid. These, as Pliny states in his fifth book, hollow out a cave, which serves them for a house; their food is the flesh of serpents, their voice a harsh noise, and they lack the intercourse of speech. In the sixth book he says, "The race of Troglodytes of marvelous speed from hunting, said to be swifter than horses." Whence Isidore in the ninth book, "The Troglodytes, a tribe of Aethiopians named for this reason because they possess such wonderful speed that they overtake wild beast by swiftness of foot." After these to the east are the Aethiopians from Nubia, and lastly those who are called Indians because of their proximity to India, with whom Pliny begins his description of the race of the Aethiopians. For according to Isidore in the ninth book, there are three principal tribes of Aethiopians, the Hesperi, Garamantes, and Indi. The Hesperi are in the west, the Garamantes in the middle, the Indi in the east. He identifies the Troglodytes with the Garamantes, who were united with them. Meroë, which is the chief city of the tribes, is located, according to Alfraganus, between the Nubians and the Indians and the Garamantes. The Garamantes, named from Garama, the chief city of their kingdom, free from marriage ties, live at random with women. The Hesperi live near Spain. For Spain is called Hesperia: whence those dwelling above Farther Spain are called Hesperi. There are, however, many other Aethiopians joined to these three tribes in different places, much degraded also from that which human nature should be, whose names, localities, and manners

it is not within the scope of the present plea to give. All these statements from the books of Pliny and of others are sufficiently clear, and should be noted in the Scriptum Principale.

Aethiopia terminates below at the Red Sea eastward, with Africa to the west and Egypt in the middle between these extremes. In this middle division is the city of Syene, of which Ezekiel speaks expressly in chapters XXIX and XXX, saying, "From the land of Syene up to the ends of Aethiopia shall the foot of man not pass." Syene is the lower limit of Aethiopia and the remotest part of Egypt, as Jerome states on Ezechiel in the ninth book. But Meroë is the upper limit of the known inhabited portion of the earth, according to Pliny. For to the south he places Meroë as the beginning of the known inhabited portion of the earth. Pliny says in the sixth book that from Syene on either side, east and west, there did not remain a town, fort, or house as far as Meroë. For all were destroyed in the constant wars, as sacred Scripture attests. From Syene to Meroë, according to Pliny in his second book, are 5000 stadia. In the sixth book, however, he gives 972 miles. Moreover, the latitude of this Syene has been stated. For it is located on the tropic of Cancer, and from it the second climate is called *clima Diasyenes* [parallel through Syene].

What follows cannot be explained unless there is here given a description of Egypt and of Africa and of the course of the Nile. The capital of Egypt is Syene, as has been said, but Egypt is twofold, namely, upper and lower. That named lower Egypt is enclosed within the Nile in the form of a triangular island, like the Greek letter called delta; and for this reason Egypt was called Delta in ancient times. This has to the east the land of the Philistines, to the north the Mediterranean Sea, to the west Africa, to the south upper Egypt. In the direction of Palestine is a mouth of the Nile called Pelusium, where falls one side of the triangle, that is, one branch of the Nile into the sea.

This is the Pelusium referred to in Ezekiel XXX, where it is said, "I shall pour out my fury on Pelusium the strength of Egypt"; and Jerome says in the ninth book, "It is called the strength of Egypt because it has a very safe harbor, and maritime interests center there." Another mouth is called Canopium, where the second arm of the triangle falls into the sea toward

Africa. Between these mouths of the Nile is the base of the triangle on the sea coast, containing 170 miles, as Pliny says in the fifth book. From the junction of the branches of the Nile at the vertex of the triangle to the mouth Canopium is a distance of 146 miles, and to the mouth Pelusium 256 miles. Upper Egypt is conterminous with Aethiopia, as Pliny says, and is called the Thebais, and begins at Syene, which is a city of the Thebais, as Jerome says in his book on Places. It has to the south, Aethiopia, to the east, part of Arabia, as is shown more clearly below; to the west, the upper part of Africa. This is the region of the Thebais, in which is the city of Thebes. Egyptian Thebes was built by Cadmus, as Isidore states in his fifteenth book. Among the cities of Egypt Thebes is considered famous by reason of the number of its gates. The Arabs bring their wares to this city from all directions. Then Cadmus journeyed to Greece and founded Grecian Thebes in Achaia, which is now called the land of the Prince of Amorea [Morea].

Lower Egypt has in the direction of Africa Alexandria on the sea, a noble city founded by Alexander the Great, which from that time became the capital of Egypt. Alexandria is on the third climate, which is named from it *clima Dialexandrios* [parallel through Alexandria], and is distant from Syene, according to Pliny in the second book of the Natural History, 5000 stadia. From this city eastward beyond the seacoast about a hundred leagues, as the experience of travelers shows, is the city of Memphis, once the stronghold and capital of Egypt, which is now called Damiata. From this city a day's journey distant is Tampnis, where Pharaoh dwelt and Moses performed his miracles, as Jerome states in the ninth book on Isaiah. On the extreme confines of Egypt, as Jerome says in his letter on Mansions is Ramises, a city toward the east, which the children of Israel built. Formerly, Jerome states in his book on Places, the whole province was so named, in which Jacob dwelt with his children; and this is the land of Gessen, as the book of Genesis states, and Jerome says, in the aforesaid book, that in it Jacob dwelt with his sons near Memphis. Not far from Tampnis is Heliopolis, city of the sun, bordering on Arabia, as Pliny says, and a city of great renown, in which, as Jerome states in the book mentioned, was the priest Phutifar, whose daughter Joseph took, as we read in Genesis, chapter XLI.

Tana is a city of Egypt, as Jerome says in his book on Places, in which the Jews dwelt who from fear of the Babylonians fled with Jeremiah, and not only in this city did they dwell, but in Memphis and in the land of Phatures and of Magdalon, as is stated in Jeremiah, chapter XLIV. Phatures, as Jerome states in his book on Places, is the part of Egypt in which exiled Jews dwelt. But Socoth and Ethan and Phiaroth and Magdalon, of which Exodus XIII and XIV speak, are not in Egypt but just outside of it, as is clear from the letter of Jerome on Mansions, and this is eastward toward the Red Sea. For these places the children of Israel set out from Egypt, before they crossed the Red Sea, as Exodus states.

I have now given, as far as is here necessary, a description of Egypt and I must now turn my attention to Africa. Although Pliny and many others write fully on this subject, yet Sallust's statement in the Jugurtha is more certain and clear, which I will give in the main, since Jerome says in his book on Places and Hegesippus in his History of Jerusalem that Sallust is a most accurate author. I shall devote greater care to this province, because although it is near us, yet it is less known than Europe and Asia; and sacred Scripture and the statements of the sacred writers and the histories require much information regarding this region. Africa is named from a descendant of Abraham named Affer, as Jerome states on Genesis, who is said to have led an army against Libya, and to have settled there after conquering his foes, and to have called his descendants Africans and the country Africa, which, however, formerly was called Libya and first of all bore the name of Phuth, from the sons of Chem, as will be explained below.

In the beginning, as Sallust states, Africa was possessed by the Getulians and Libyans. The Getulians, as Isadore once stated, also Hygucio, came by sea from the north from the Getae or Gotae. But Jerome on Genesis is author of the statement that they came from Evila, the son of Chus, the son of Chem, the son of Noah; nor is it likely that foreigners in the first instance inhabited a land destined for a nation, whence Africa was destined for the sons of Chem, like Egypt and Aethiopia. The Libyans were the children of Labaim, the children of Mesraym, the children of Chus, the children of Chem, as Jerome states on Genesis. From this Labaim Libya was

called, although according to Jerome on Genesis and on the last chapter of Isaiah, Libya was formerly called Phuth or the region of Phuth, from the son of Chem named Phuth. For there is still a river in Libya called Phuth, and the whole region was so named. The Getulians dwelt more toward Egypt and the Libyans toward the west, both roving more widely owing to the broad extent of the regions. Sometimes the whole of Africa was called Libya, so named from an important part, and the tribes of the country were called Libyans, who are mentioned in the second book of the Apocrypha, chapters XII and XVI, and in the third chapter of Nahum, and frequently elsewhere. But, as Sallust says, after Hercules died in Spain, his army, composed of various races, disbanded. Of this number Medes, Persians, and Armenians, passing over to Africa in ships, seized the localities bordering on our sea; but the Persians settled more in the interior and nearer Egypt and Italy than those dwelling near the sea under the Getulians. For the Getulians were nearer to the sun and were close to Aethiopia. These gradually united with the Getulians by marriage. He infers, moreover, that because in their frequent trials of new fields they had sought other places thereafter, they called themselves Numidians, that is, a people roving and wandering without a town, as Isidore says in the ninth book. The Medes and Armenians beyond the coast of our sea dwelt from the Numidians as far as Gibraltar under the Libyans, who were confined beyond them to the south toward the Aethiopians. But gradually the Libyans corrupted the name of the Medes, calling them Mauri in their barbarous tongue. All these dwelt from the ocean and Gibraltar as far as the province of the Carthaginians. For according to Sallust in later times Phoenicians coming from Tyre and Sidon in their desire for empire invaded parts of Africa, and pressed together Numidians and Getulians and other Africans, and made Carthage or the province a stronghold, in which there are famous Punic, that is, Phoenician, cities, namely, Hippo, the city of the blessed Augustine, Utica of the great Cato, and Carthage, which was like another Rome. The empire of Carthage extended toward Egypt as far as Arae Philenorum, which the Seventy-two Translators have placed in Ezekiel, where the Hebrew has Tharsi, as Jerome says in his book on Places, and not only have they done so there,

but in Isaiah XXIII and frequently elsewhere. Ezekiel XXVII is understood as referring to the Carthaginians.

Then follows the Tripolitan region, belonging to those who inhabit Byzacium, which Tyrians and Sidonians seized, whence it is called Africa or Libya Phoenices, because Phoenicians, namely, Tyrians and Sidonians, inhabited it. This country is very fertile, for it yields fruit a hundred-fold, as Pliny states. There famous Leptis is situated between the Lesser Syrtis in the direction of the Carthaginians and the Greater Syrtis in the direction of Egypt; which, as Sallust describes them, are shallow places full of sand, and when stirred by the winds and waves of the sea belch forth dust and sands copiously, whence they are called syrtes from drawing or pulling sands and dust. For *syrma* in Greek is *tractus* [drawing] in Latin; and *syro* is the same as *traho* [I draw]; whence they annoy and disturb those inhabiting the adjoining localities.

Then follows the province of Pentapolis, which is called Cyrenean in the Scripture, where there are five great cities, of which the chief is called Cyrene, of which mention is made in the Gospel of Luke, also in Mark and in Matthew. When the Lord was being led to his Passion "they laid hold upon one Simon a Cyrenian, etc." And in the Acts of the Apostles, "And there arose of the synagogue which was called that of the Libertines and of Cyreneans, etc.," and in the fourth book of Kings, chapter XXVI, it is stated that the king of the Assyrians transferred the people of Damascus to Cyrene; and in Amos V and IX there are references to this city. Since, however, Arae Philenorum is found in many writings of the sacred authors and in the histories, and frequently is read corruptly, so as to be called Arae Philistinorum, for this reason to avoid error it is worth while to consider what Sallust says on this subject. For after the Cyreneans and Carthaginians had waged many wars, and since the boundaries between the kingdoms had not been settled, for the sake of peace they decreed that on the same day and hour envoys should be sent from both cities, and that where they met should be the boundaries of the kingdoms. But the envoys of the Cyreneans, hindered by chance, were not able to advance as far as they wished. They pretended, therefore, that the Carthaginians had departed from their place sooner than they should have done, and said that they should be buried alive at the place

which they had reached, if they wished to keep it as the boundary of their kingdom; or that the Carthaginians should allow them to pass through to the point they wished to reach; and that they themselves would there choose death. The envoys of the Carthaginians agreed, and the chief men were two brothers, who were named Philenes or Phileni. These two with their own consent were buried alive for the sake of their country, in memory of whom the Carthaginians erected altars which are called the altars of the Phileni to this day. Under the province of the Cyreneans is reckoned the whole country as far as Egypt, according to many authors; but Pliny defines it as a small province by itself, which is called by him Libya Mareotis. And thus is terminated the stretch of the whole of Africa from Gibraltar to Egypt, with the distinction of its provinces.

Above Egypt and Africa, to the south extends Aethiopia from east to west as far as the Aethiopic Sea, and the principal regions are those, as I have said, of the Indians, Sabaeans, who belong to Meroë, Nubians, Troglodytes, Garamantes, and Hesperi. Part of the country of the Troglodytes bends toward the west beyond the Greater Syrtis and neighboring parts, from which it seems to be distant, according to Pliny in the fifth book, a journey of eighteen days. Therefore although the greater part of the race of the Troglodytes lies toward the Red Sea, yet some portion of it bends toward the west beyond the regions of Africa. Beyond these westward is the region of the Garamantes in the direction of the Lesser Syrtis and of the Carthaginians; the eastern portion, however, of the Garamantes lies in the direction of the district of Cyrene, according to Pliny in his sixth book, so that they reach at length the Hesperides to the west in the region of Mount Atlas.

Since the Nile waters Egypt and Aethiopia, and separates in many ways their provinces, and is frequently mentioned in Scripture, and is a familiar topic in philosophy and in the histories, it is quite fitting that some account of it should be given. It rises in paradise, as Scripture states, but where it breaks forth into our inhabited world is reckoned differently by different authorities. It is, however, likely that it rises in Aethiopia on the shore at the beginning of the Red Sea, as Orosius affirms in his book Ormesta Mundi to the blessed Augustine, and Seneca in the third book of his Natural Questions

practically agrees. For he states that the emperor Nero sent two centurions to explore the source of the Nile, and when they came to the first king of the Aethiopians they were instructed and aided by him, in order that the other kings of the Aethiopians might grant them safe conduct. At length they came to shallow marshes filled with vegetation, the extent of which was unknown to the inhabitants; and they despaired of ascertaining it. For they could explore neither in a boat owing to the shallowness of the water, nor could the muddy ground support the weight of a man. The inhabitants therefore believed that the head of the Nile was in this place. Therefore Pliny's statement that the Nile rises at the confines of the west near Mount Atlas not far from the sea is not to be believed. For the double testimony is stronger here than the single one, and the experience of the emperor Nero is much to the point.

An African river flows into the region which is called Egyptian Libya, to an immense lake in which it ends, as Orosius says. There is the additional fact that paradise is in the east. Therefore it is more likely that the Nile breaks through in the east than in the west; nor is the African river one and the same as the Nile, although they do nourish similar fishes and like monsters and crocodiles, as Pliny argues, because we see rivers in different regions nourishing creatures similar in species; and according to Pliny himself and others rivers in India nourish crocodiles like the Nile. But his statement that the Nile of Egypt is augmented by rains and snows through the African river must be accepted, because it is possible that the lake mentioned, into which the river empties, drains by a hidden passage into the bed of the Nile, a phenomenon familiar to us in many different regions.

The course of the Nile from its source through Aethiopia and Egypt is described by Pliny and others, although in regard to its source he does not agree with others. It flows, then, from its source, as Orosius says, for a long time to the west, and crosses through the middle of Aethiopia, forming many islands, of which Meroë is the most famous, which is also called Saba. Then bending to the north between Meroë and Syene, as Pliny explains, and inclosed by mountains it forms cataracts amid the opposing rocks, so that it does not seem to flow but to rush, where it deprives the inhabitants of the sense of hear-

ing by its excessive noise. For this reason they emigrated to quieter localities, as Seneca says in the eighth book of his Natural Questions. I mention this fact, because Macrobius the Pythagorean, wishing to show how we uninjured endure with our ears the endless noise from the motion of the heavens, gives a pointless example regarding the race which calmly endures from habit the roaring of the Nile. But his example is an erroneous one, as Pliny and Seneca show, and cannot be cited, as Aristotle shows in the second book of the Heavens and the World. This place is near Syene, according to Jerome in the ninth book on Ezekiel; and he states that as far as Syene the Nile is navigable from the Italic Sea. The Nile continues on to the north and at length projects its mouth into the sea between Egypt and Italy. It has two mouths, namely, that at Pelusium and that at Canopus. Moreover, as Jerome says in the fourth book, on Isaiah, chapter XIX, the Nile before Augustus Caesar had a single channel, but was then divided into seven, whence one branch flows down to Pelusium, and flows to Memphis, which is Damiata; and another branch extends upward to the south as far as Kayr and Babylonia, from which it is now called the Soldanus of Babylonia, about three days' journey from Damiata. From Damiata a branch of the river extends laterally about southeast to a village called Lancassor, where a Christian army was defeated, when Lord Louis, son of Louis the son of Philip, famous king of France, first took the Cross to parts across the sea. Other branches of the Nile flow down near Tampnis and Alexandria and other places of Egypt.

Now according to Pliny and others a peculiarity of the Nile is the fact that it inundates at certain times and waters the plains of Egypt. According to the overflow of the river is fertility granted or denied to Egypt. For if it passes beyond its natural limits by only twelve cubits, Egypt feels hunger; if for thirteen cubits, Egypt is no longer hungry; fourteen cubits bring joyousness, fifteen security, sixteen delight. If its overflow is still greater yet in moderation, it rouses the inhabitants to an abuse of pleasure. If its overflow is excessive, harm is done, as Seneca states. The Nile begins to increase, authorities state, at any new moon after the solstice sensibly, that is, by degrees and moderately, while the sun is passing through Cancer, and most abundantly while he is in Leo, and the river rises

no further while the sun is in Virgo. In the same way in which it rose is it called back within its banks while the sun is in Libra and on the hundredth day from the beginning of its flow. It is difficult to assign the reasons of this inundation and increase, since it is very strange occurring in the heat of summer as it does when waters are consumed more than at other times. But no other river has an inundation of this kind, according to Aristotle in his treatise on the Nile; according to Pliny no river except the Euphrates. We can, however, name a third one, namely, the Ethilia, which is larger than the Euphrates and forms the Caspian Sea, of which I spoke above. This fact is attested by those who were among the Tartars, as Friar William and others. Aristotle, however, and Pliny spoke in accordance with their experiences.

A natural peculiarity of this kind, which is found in very few rivers of the world, is quite remarkable. Moreover, the almost endless disagreement of learned men over the causes of this increase induces perplexity in us, so that it is not clear what view we should adopt, especially since many authors reject theories as probable as those which they affirm. Seneca also, more definite than all other authors, with the possible exception of Aristotle, in every matter on which he fixes his attention, offers on the present question merely rejected theories in his book on the Nile, which is the eighth of the Natural Questions. Seneca is defeated by this difficulty, although gloriously victorious elsewhere. Aristotle, too, although he intersperses opinions, yet can always be doubted, owing to many contradictions. I shall state with tolerable brevity the conflicting views which I consider the more important ones to give for the sake of this plea which is preliminary to the principal treatise.

Latin scientists, neglecting experience in this matter, adhere to the theory of Thales, who was first of the seven wise men. His theory was that yearly settled winds blow opposite to the mouths of the Nile rolling back the waves and sands of the sea, by which the mouths are obstructed, and the waters of the Nile flow back to the interior, and thus the river overflows its banks. But this theory is found to be false by authority and experience. For according to Aristotle and Seneca and in accordance with what the experience of those who have been in Egypt shows, the waters of the Nile begin to flow from the

upper part of Egypt from Aethiopia. For the Egyptians exulting for joy go aboard boats and hasten to meet the down-flowing Nile with singing and many kinds of musical instruments. Hence the river does not begin to flow from the mouths previously mentioned, but from the upper portion toward the mouths.

Anaxagoras the philosopher offers a theory more probable than all the others, and states that the snow melts in summer in the mountains of Aethiopia, and that the Nile is thus augmented, just as the Rhone, Po, Danube, and rivers of this kind near the Alps are increased from the melting of the snow. But this theory Aristotle and Seneca deny and reprobate. Aristotle refutes it by the fact that only a little water is produced from a great quantity of snow, but the increase in the Nile is very great, because it inundated very wide districts sometimes to a depth of thirty cubits. Again he argues in another way. Waters flowing from a distance are stronger at the end, just like winds coming from a remote quarter, while those from a point near at hand are more impetuous at the beginning. This reason is applicable to the waters, because in a great distance many different waters flow together into one body and there are many rains and many vapors come from the earth, and therefore all rivers are strengthened toward their end and are larger than at their source. This is true also of the winds, owing to the multiplication of vapors flowing together into one body from different places on account of the great distance. But the inundation of the Nile is an augmented one at the beginning and grows stronger and stronger for a time, until it diminishes at the end, as Aristotle and Pliny state, and experience teaches. Therefore those waters do not come from a remote locality, but even the mountains of Aethiopia, where it might be said with greater probability that snows abound, are distant from the Nile a journey of five months. Therefore the inundation of the Nile is not caused by snows. The major proposition of this argument is quite sound; for it contains much scientific knowledge, whatever may be the case with the minor proposition. Again he states that at full moon all congealed substances melt and are more resolved, but the Nile increases at the end of the month, an increase not due, therefore, to snows. Again, the Nile flows more when the north wind blows than when the south wind

blows; but the south wind to a greater extent dissolves snows because it is a warm wind. But Aristotle says that in Aethiopia, owing to the very great heat which consumes all things, snows cannot exist, a statement that must be readily believed. Seneca agrees in these matters and adds that snows dissolve in the spring and melt when touched by moderate heat and cause an increase in the rivers; but that the heat is never moderate in Aethiopia before the winter. The Nile, however, rises after the summer solstice. In this preliminary plea it is not necessary to state the theories of Pythagoras, Diogenes, Democritus, or of many other philosophers.

But let us quote in place of them all the theory of Aristotle, who says that in Aethiopia in our summer there are many rains and none in winter, and that the Nile rises in those regions, whence the swamps and lakes are augmented; and he adds that yearly settled winds blow in summer from the east and drive the clouds to the regions whence the Nile flows, which are dissolved into its lakes. The reason why the river is augmented at the end of the month is given by Aristotle in the second book of the Posteriores, because the end of the lunar month is colder, and cold multiplies moisture and is increased by the north wind, since that wind drives the clouds naturally because of its impetuosity. It has this quality since it comes from near by, for its habitation is in the northern quarter of the earth, and it is impetuous in this quarter, as Aristotle teaches, and for this reason drives the clouds before it, so that they can collect over the swamps of the Nile, which are of almost incomprehensible size, as was explained above. They receive, therefore, much from the region of the clouds and their waters can thus be multiplied through the resolution of the clouds into rains.

But as in the case of the other theories, objections can be urged against this one. For since the country is uninhabitable owing to the heat, that is, very unsuitable for habitation since it is parched, how can there be an abundance of rain and especially in summer, in the same way that there can be no snows, as Aristotle himself argues in opposition to the second theory? Against the first theory he says that the same thing would happen in other rivers, and that annual winds do not always arrive at their accustomed times. Since, then, there are rains in many regions where there are great rivers and annual winds, and yet

we do not see an increase of this nature; and the north wind likewise drives the clouds with greater force in regions near by, because the wind is less distant from its origin; hence, rivers in our localities would be the more increased and likewise at the end of the month; but we see no such increase. Wherefore it is very difficult to give the reasons for this strange increase, because it occurs only in the Nile, according to Aristotle, or at least only in the Nile and Euphrates, according to Pliny. It happened, however, in still a third river mentioned above, namely, in the Jordan before the destruction of Sodom and the neighboring cities, on the testimony of the Scripture in Genesis. Therefore owing to the difficulty of this subject it suffices in this plea that we learn the views of the philosophers, in order that, stimulated by these ideas, we may inquire with greater certainty into the truth in the more important treatise.

We must return, then, to the description of the regions. We shall find in Pliny in the sixth book, Alfraganus and Lucan also agreeing, that the ancients called part of Arabia all the land which is inhabited from the Aethiopic Sea and the south passing through Meroë and Syene, so also that the Heliopolis of Egypt, of which mention has been made, is reckoned in Arabia; and therefore all that country which is inhabited from Meroë, Syene, and Heliopolis toward the east between the Red Sea and the Aethiopic Sea is included under Arabia. Hence Alfraganus placed on the first and second climates the island of the Arabs. This island is in the Aethiopic Sea or near the beginning of the Red Sea. Lucan says, "You Arabs have come to a world unknown to you who wonder that the shadows of the forests do not fall to the left." He says this respecting the Arabs who came to Rome in aid of Pompey, who were surprised that shadows to the left, namely, to the north do not pass, that is, do not change to the right or south. For in their country, which lies between the tropic of Cancer and the equinoctial circle, they have in one part of the year shadows to the south when the sun passes beyond them toward the tropic of Cancer, because the sun is then in the north with respect to them: and when it passes beyond them toward the equinoctial circle, then of necessity they have shadows to the north because the sun is to the south of them. All this part of Aethiopia around Meroë, Syene, and Heliopolis toward the east is in-

cluded under Arabia; and not only this section, but whatever there is around the tongue, that is, the extremity of the Red Sea and beyond its shore eastward from the point of its tongue to its Persian Gulf. It extends from the Red Sea as far as Pelusium in Egypt to the west, and spreads to the north through the whole of the desert in which the children of Israel wandered as far as the land of the Philistines above our sea bounded by Egypt, and extending eastward until the region of the Amalechites is reached, which lies to the east of the land of Philistia, and as far as the land of Edom, or Idumaea, lying to the east of Amalech and reaching as far as the land of Moab. Then it turns more to the north through the land of Sehon, king of Esebon, and of Og, king of Bashan, as far as Mount Galaad and Lebanon, and turns still more to the north as far as Cilicia and Syria Commagene, and as far as the Euphrates.

Whence taken in its widest meaning it is a very great land, and contains in it first the Desert of Sur or Ethan, for Ethan is called a desert on both sides of the Red Sea and at its extremity is united to Egypt and Palestine, since it is stated in Exodus that the children of Israel encamped in Ethan; and that they crossed the Red Sea and came again into Ethan. For the Scripture says that after the passage of the Red Sea they came into the desert of Sur, and there pitched their tents in Mara, and marched for three days before they pitched their tents, and first they pitched their tents in Mara and then in Helim. But Jerome says in his letter on the Mansions that the desert of Sur and Ethan are the same. In this Arabia near Sur toward the east, beyond where the children of Israel crossed, beyond the shore of the Red Sea, is the country of the Elamites according to Pliny and Jerome in his book of Interpretations. Here is the city of Elam, the remotest city belonging to the people of Palestine. For in this part near the desert of Sur an angle of Palestine turns toward the Red Sea, according to Jerome. Pliny says Stagnos* is near there, an island of the Red Sea, which dogs do not enter, and if landed die wandering over all the shores.

After the desert of Sur toward the east follows the desert of Sin, where there were five sojournings of the children of Israel according to Jerome in his letter on the Mansions, of which

* See Bridges' note, Vol. I, page 326.

the first is not given in Exodus, but in the thirty-third chapter of Numbers, where it is said, "and they proceeded from Helim to the Red Sea which is called Jamsuph." Jerome asks how they returned to the Red Sea, and he gives a double solution of the difficulty, namely, that there might have been a gulf of the Red Sea extending into the desert of Sur from the main body of the sea, for *Iam* means sea and *Suph* red. But his second solution is better. *Suph,* he says, can signify red or bulrush, and here it does not have to be taken as red but is to be understood as bulrush. Hence he says that we can imagine that they came to a certain swamp and lake, which was full of sedge and rushes. That, moreover, sacred Scripture calls every collection of waters a sea there is no doubt. Here, therefore, according to the correct interpretation of the Hebrew the word signifies a marsh of rushes. But since the former rendering became too widely known in the ancient translation, where this sojourning is called the Red Sea, Jerome allowed it to stand in our version, as it had been in the ancient one, just as he did in many other passages throughout the whole body of Scripture. The last of those five sojournings, which was the eleventh from the exodus of the children of Israel from Egypt, is Raphidim directly to the north belonging to the country of the Amalechites, which fought with the children of Israel and was defeated by them. Then more toward the east is the desert of Sinai, where Mount Sinai is situated, which is the Mount of God Oreb, as Jerome says in his book of Places. But the rock Oreb is not at Raphidim, from which Moses drew water. For Horeb meaning Mount Sina is written with the letter *heth,* but Oreb without it. Then come the sepulchers of concupiscence and Asseroth, which are two sojournings after Mount Sinai in this desert of Sinai.

Then more to the east is the desert of Pharan, where the country of the Ishmaelites begins toward the Red Sea to the east. But to the north of Pharan is Ebron, the city of David, and the place where mighty Adam and Abraham and Isaac and Jacob were buried. By the way of the desert between Pharan and Ebron Moses sent Joshua and Caleph and other spies. In this desert of Pharan, as Jerome says in his book on the Mansions, the children of Israel made eighteen sojournings, from the twenty-fifth to the thirty-second, by counting the extremes

with the means, so that the last is Asyongaber; whence the desert of Pharan is very extensive. Here were they smitten by the Amalechites and the Canaanites, and here the Lord gave judgments, and the sedition of Chora arose, the rod of Aaron budded, and many other things happened, as is manifest from the thirteenth chapter of Numbers to the twentieth.

After leaving the desert of Pharan they passed more to the east to the desert of Sin, which is Cades Barne, where the people murmured at the waters of strife. But this is not that former desert of Sin. For it was much more distant from the Red Sea, with the land of Edom joining it to the northeast. For from this place the children of Israel sent envoys to Edom saying, "Lo, in the city of Cades, which is in your remotest confines encamped we beg permission to pass through," as the eighteenth chapter of Numbers states. But if any one contends that the desert of Sin mentioned above can extend to this place, it is manifestly not so, as shown by Jerome in his letter on the Mansions, by interpretation, and by Scripture, since the first Sin is written with a *samech* and is translated bramble bush or hatred; but this one is written with a *sade* and is translated command. Therefore the children of Israel turned aside by the way which leads to the Red Sea, passing around the land of Edom, and came to Mount Or in the remotest confines of that land, on which mountain Aaron died.

In the territories of the land of Edom they made three more sojournings, according to Jerome, until they reached the boundaries of Moab, whence Moab is east of Edom. For departing from the territories of Edom they pitched their tents in the desert which looks toward Moab facing the east, as the twenty-first chapter of Numbers states. Then, as Deuteronomy, chapter II, states, they passed a city of Moab called Ar and came to the confines of Ammon. In these localities there begins to the east the land of Sehon, king of the Amorites, and the land of the Ammonites, and therefore these places must be carefully considered. For here begins the land of the children of Israel, and concerning these places much is said in Scripture and in the sacred writers. There is, then, on the border of these places a cliff rising on high called Arnon, and this cliff marks the limits of the children of Ammon and of Moab, and of King Sehon of the Amorites. Hence the land of

the children of Israel begins here. But beneath this cliff is a valley called Arnon, near which on the southern side is the city of Ar, capital of the kingdom of the Moabites, which was afterwards called Ariopolis, compounded from the Hebrew word and the Greek, that is, city of the adversary, as Jerome says in the fifth book, commenting on the prophet Isaiah. Moreover, from this cliff a torrent flows toward the west, called the torrent of Arnon, beyond the bank of which is situated a town called Aroer near the Arnon. These facts are attested from the book on Places of Jerome, from the text in the book of Numbers, chapter XXI, of Deuteronomy, chapters II and III, of Joshua, chapter XIII, of Judges, chapter XI, and from many other passages of Scripture.

The land, then, of Moab ascends from the Arnon westward to Edom and to the Dead Sea and to the region where the submerged cities were located, and to the Jordan opposite Jericho, as is clear from the aforesaid passages of Scripture and of Jerome. Below the land of Moab near the Arnon and Ariopolis is Madian, the city of Jethro, father-in-law of Moses, as Jerome states in his book of Places. Here necessarily must be the Midianites. For as is clear from Numbers, chapters XXII, XXIII, XXIV, and XXV, Balac, king of the Moabites, called Balaam the seer to curse Israel, who counseled to offer them the daughters of the Midianites, and they sinned with them and many of the Israelites were slain. Later the Midianites were destroyed and wiped out by the children of Israel. On the other side of the torrent Arnon, the land of the children of Ammon began toward the north and east, stretching toward the Euphrates, and toward the west a corner of it toward the Jordan reaches the ford or torrent of Jacob, which Jacob crossed coming from Mesopotamia in Syria. The angel wrestled with him after his passage of this stream, as Genesis, chapter XXXII, records.

That at this torrent of Jacob is the boundary of the children of Ammon is made clear by Deuteronomy, chapter III. Here is the boundary of Ammon and of Sehon, king of the Amorites, and of Og, king of Basan, as is clear from Judges, chapter XII. For from Jacob the land of Sehon began, as is there stated; and where his land ends, the land of Og, king of Basan, begins and extends also nearly to the torrent of Arnon and the

confines of Esebona, city of King Sehon of the Amorites. Therefore the land which belonged to Sehon is bounded to the south by the Moabites and to the east by the Ammonites, and to the west has the river Jordan, and to the north the land of Og, king of Basan. But Sehon, becoming more powerful, invaded the countries of Moab and Ammon, and took away their lands. For that he took away the land of the children of Ammon is established from Judges, chapter XI; and that the children of Ammon lost half of their country is shown by Joshua, chapter XIII. Moab also lost much, as is clear from Numbers, chapter XXI.

Since these regions in the direction of the tongue of the Red Sea have been discovered by means of the sojournings of the children of Israel, we must consider besides that in the deserts lying between the Red Sea and the lands named are other vast regions which extend around the aforesaid lands, namely, the land of the children of Ammon and of Moab, and the desert of Pharan, as far as the land of Elamites, which I said above was situated above the coast of the Red Sea from the passage of the children of Israel on toward the east. In this region, then, and likewise in Pharan, dwelt the children of Kentura and Agar, descendants of Abraham, of whom mention is made in Genesis, chapter XXV. And first from the Euphrates begins the Nabathaean country, so named from the first son of Ishmael, who was called Nabaioth, as Jerome states on Genesis, chapter XXV, and Pliny agrees with the statement in his first book, except that he calls one part of the Nabathaeans Nomads, who wander about the Euphrates near the Chaldeans. After these toward the desert of Pharan is the region of Cedar, which is named from the second of Ishmael's sons, who was called Cedar. Although other regions belonging to the children of Ishmael are named as far as Sur, for he dwelt from Evila as far as Sur, as the Scripture states, yet all these regions are called Cedar, as Jerome maintains in his fifth book commenting on that Burden upon Arabia in Isaiah, chapter XXI. He says, "Here he is speaking for Kedar, which is the country of the Ishmaelites, who are called Agareni and Saracens by a wrong name." In the seventh book, commenting on Isaiah, chapter IX, he says in regard to these regions of Cedar and Nabathaena that Cedar is the country of the Saracens, who

in Scripture are called Ishmaelites, and Nabaioth is one of the sons of Ishmael, from whose names the desert is called, which lacks crops, but is filled with cattle. Evila is a part of the country of Ishmael distant from the town of Pharan in the desert of Pharan a three days' journey, as is stated in the book on Places. There is also another region called Evila in India near the river Ganges, of which mention is made in the first chapter of Genesis.

Between Cedar and the region of the Elamites mentioned above extends the region of Saba beyond the shore of the Red Sea, according to Pliny, book V. This region produces incense and is filled with spices and has three divisions. One is called Arabia Eudaemon, which is included between the Persian Gulf of the Red Sea and the Gulf of Arabia, according to Orosius in his book Ormesta Mundi, and according to Isidore, book XIV. The second is Madian, called from a son of Abraham and Ketura. The third is Epha, a region called from a son of Madian, as is clear from Genesis XXV. That, moreover, these two regions are part of the kingdom of Saba, Jerome maintains expressly in his comment on Isaiah XVII, saying "Madian and Epha are regions abounding in camels and the whole province is called Saba; whence was the queen of Saba," as he states. That Arabia Eudaemon is part of Saba is manifest, because it joins immediately the Chaldeans, as Orosius states. The Chaldeans and the Sabaeans their neighbors attacked at the same time the cattle of the most holy Job, as is clear from the first chapter of his book. This is also clearly stated by Isidore in his fourteenth book, who speaks as follows, "Arabia is called sacred, because the region produces incense and perfumes." The Greeks have called this land Eudaemon, and our writers Beata [blessed], in whose pastures are produced myrrh and cinnamon; and there is the phoenix born. This land is also called Saba from the son of Chus, son of Chem, son of Noah, and this son of Chus was called Saba. This fact is stated by Jerome in his Hebrew Questions. Therefore when Madian and Epha are enumerated in Isaiah, chapter IX, Saba also is added, when he says, "All they from Sheba shall come." For Arabia Eudaemon in particular is called Saba chiefly, although that whole region and Madian and Epha are

called Saba. Therefore the whole region from the Chaldeans beyond the Red Sea as far as Elam is called Sabaea.

We must here note the fact owing to some contrarieties that Arabia taken broadly includes all the regions mentioned on both sides of the Red Sea according to Pliny, Alfraganus, and the ancient philosophers. Taken, however, in the more restricted sense it is understood to be only the region which extends from the tongue of the Red Sea as far as the Euphrates and the Persian Gulf toward the east, and as far as Idumaean Palestine toward the north in one of its parts, of which the other part to the north and more to the east extends to Mount Lebanon, and embraces the whole region of Moab and of the children of Ammon and the kingdoms of Sehon and of Og, king of Basan, and some regions connected with these. Such is the usage of Scripture, as, for example, in Isaiah when he says, "The burden upon Arabia," where Kedar is included under it; and Mount Sinai is thus in Arabia, as the Apostle states in Galatians, chapter IV. In a still more restricted third sense it is taken so as to exclude Pharan, Cedar, Madian, Epha, and Saba Eudaemon. For thus in the time of Jerome and thereafter was Arabia understood, since he himself says in his book of Places that Pharan is beyond Arabia. Also in the fourth book and in the seventeenth, commenting on Isaiah, he says that Madian, Cedar, and Nabathaea are regions beyond Arabia. That incense-producing Saba Eudaemon and all the region of Saba are distinct likewise from the Arabia mentioned in that third sense is clear from Jerome in his Hebrew Questions. For he says that when it is said in the Psalms, "The Kings of the Arabs and of Saba shall bring gifts," the fragrant and incense-producing Saba is meant, concerning which he cites the authority of Vergil. "To the Sabaeans alone," he says, "belongs the frankincense shrub." For as Jerome says and as is clear to any one acquainted with Hebrew, in the Hebrew the statement is, "The Kings of Saba and Saba shall bring gifts." But the first Saba is interpreted Arabia and is written with the letter *sin,* the second is written with the *samec,* and is the famous incense-producing Saba, and from this Saba came the magi, who worshiped Christ, not from the Saba which is in Aethiopia. For according to the Gospel the magi came from

the East, and those are the kings of Saba, or the kings of the Arabs and of Saba.

After these divisions there follows a very large region called Syria, which according to Scripture, Pliny, and other ancient authors contains all the provinces from the Tigris River on the east as far as Arabia on the south and as far as our sea on the west or the great sea, dividing Italy and Syria and Egypt, and from Cilicia and the very lofty Taurus range on the north. Its first and principal region is Mesopotamia or Assyria, for they are the same according to Pliny. Jerome, moreover, states in the third book, commenting on Isaiah, that the whole region between the Tigris and the Euphrates is the country of the Assyrians. Similarly Mesopotamia is included between the Tigris and the Euphrates. Whence it is named from *meson,* meaning middle, and *potamus* meaning river, as if contained between two rivers, the Tigris, namely, and the Euphrates. Therefore, in ancient times Mesopotamia and Assyria were identical. This Mesopotamia or Assyria on the east has the Tigris, on the west the Euphrates, on the south the Persian Sea, which is the Persian Gulf of the Red Sea, on the north the Taurus range. Its length is about 800 miles, and width 300, according to Pliny. In Mesopotamia are Nineveh and Babylon, and all the land of the Chaldeans, and the tower of Babel constructed in the land of Senaar. In Mesopotamia, moreover, are the cities which Nimroth built, namely, Arad, that is, Edissam, and Archad, which is now called Nisibis, or commonly Nisibin, and Calampne, which was afterwards named by King Seleucus Seleucia, as Jerome explains in his comment on the tenth chapter of Genesis. Moreover, in Mesopotamia is Aram, as is stated in Genesis, which still retains its name. Aram is distant two days' journey from the Euphrates, and Jerome says that Aram is beyond Edissa. Therefore Edissa is between Aram and the Euphrates, and Nineveh is about ten days' march from Aram, that is, eastward beyond the Tigris River, according to the statement of Scripture that the Tigris flows opposite the Assyrians. For the Ninevites were generally called Assyrians. From Aram to Baldac toward the south is a journey of about twenty-six days. Baldac is a royal city, in which the caliph lord of the sect of the Saracens has established the seat of his dignity. In those parts is the tower of Babel, and the mighty ruins of

Babylon, which was the capital of the kingdom of the Babylonians and Chaldeans, since they had been Mesopotamians and Assyrians from the beginning, as the whole land between the Tigris and Euphrates was called Mesopotamia and Assyria, and since Babylon, capital of the Chaldean races, possessed the greatest renown among cities in the whole world. The remaining part of Mesopotamia and of Assyria was called Babylonia, as Pliny states, so that at length the Babylonians prevailed. For as is clear from the books of Kings and the Apocrypha at first they were called the kings of the Assyrians, as Salmanasar and Sennacherib and others. Then Nabugodonosor, king of Babylon, and his successors ravaged the Assyrians, and became masters through the whole region between the Tigris and the Euphrates. Noah and his sons at first after the flood dwelt in Babylonia, as Albumazar says in the fifth book in his larger Introduction to Astronomy. For since they themselves were clever astronomers and were first to teach the Chaldean astronomy, as he states in the same book, they knew that the fourth climate is the most temperate, in which Babylon is, and for this reason turned aside to it.

Since the Tigris and the Euphrates are two of the four principal rivers of the world and numbered along with the Nile, something must be said about them. Their source is variously given. For as a matter of fact their origin at first is in paradise, as Scripture maintains. Then, according to Pliny, the Tigris bursts forth in greater Armenia and later empties into a lake supporting all weights placed on it and exhaling mists. The lake has only one kind of fish which do not enter the channel of the water flowing through it, nor do the fish from the Tigris swim into the lake. Then when the Taurus range meets it the river plunges into a cavern, and on the other side of the mountain bursts forth into a lake, and afterwards returns to the form of a river and joins the Euphrates, and flows through Nineveh, and after a long course empties into a gulf of the Red Sea which is called the Persian Gulf. The Euphrates, according to Pliny, book V, rising in greater Armenia, separates Cappadocia from it, then it is met by the Taurus range after flowing to the west. Again it turns southward and divides into two branches. One branch empties into the Tigris inclosing on the north Mesopotamia, the other branch waters it on the

west and flows through the middle of Babylonia, as Orosius says to Augustine, then flows into swamps, and finally into the Persian Sea. For the Chaldeans are in Babylonia southward toward the Persian Sea, and the Euphrates waters them, like the rest of the Mesopotamians and Assyrians, on the west, separating them from the other regions of Syria and from Arabia. The Euphrates, as Pliny says, swells like the Nile, differing little from it. For it inundates Mesopotamia when the sun reaches the twentieth part of Cancer, and begins to fall when the sun is in Virgo after Leo has been traversed. The inundation is over at the thirty-ninth part of the Virgin. The statement of Boetius in the fifth book on Consolation and that of Sallust that the Tigris and the Euphrates flow from the same source can be understood of their source in paradise; for this is a fact according to Scripture, with which Boetius at least was well acquainted, and Sallust might have believed from a study of the history in the Scriptures. This is also true as regards their origin in Armenia, since both rivers have their source there, according to Pliny; or it can be understood of their source this side of the Taurus range, for when they meet it they sink into the ground, and burst forth on the other side.

From the Euphrates which flows in the east extends Arabia, of which mention has been made, toward the south and the Red Sea. Toward the north are the remaining regions of Syria, namely, Syria-Comagena, Syria-Coele or Coele-Syria, and the Syria of Phoenicia, and the Syria of Palestine, which includes the provinces held by the Jews, namely, Judea, Samaria, and Galilee this side of the Jordan, and the region across the Jordan which the tribes of Reuben and Gad possessed, and the half tribe of Manasseh, where the region of Decapolis lies and Iturea or the region of Trachonitis.

In these provinces are found all the sacred places that first the holy patriarchs and prophets trod, then the lord himself and his Mother and the holy Apostles, and in which the primitive Church grew. With these places the Gospels resound, in which greater mysteries are contained than mortal ear can hear or human mind understand, as Origen maintains, commenting on Joshua, chapter XVIII. Wherefore I must speak with more care regarding them.

First, then, we must locate the famous cities on our sea or near it, which divides Italy and Egypt and Syria, so that further to the east the places that we wish may be easily grasped by the understanding. First, then, there is the famous city of Gaza in Palestine, not on the sea, but near it, about three leagues distant, on the confines of Egypt, Palestine, and Judea, as Jerome says in his book on Places. Then nine leagues distant is Ascalon, the metropolis of Palestine, situated on the sea. Joppa is twelve leagues distant. Then comes Acon, distant twenty-four leagues, or a journey perhaps of two days. For it is two or three leagues to Assur, formerly called Azotus, and then nine or ten to Caesarea in Palestine, in ancient times called Stratonis turris, where Peter baptized Cornelius, as Jerome states in many places. Five leagues further is Castrum perigrini, and three more to Caiphas and then four to Acon. Tyre is nine leagues distant in the heart of the sea. Four or five leagues distant is Sidonian Sarepta, where the widow fed the prophet Elijah; then three or four leagues further is Sidon, and eight or nine more is Berithum, which is called Barut. Then nine leagues further is Biblium, which is now called Gibeleth, in regard to which Ezekiel, chapter XXVII, says, "The ancients of Biblium and the wise men thereof had mariners." Tripolis is nine leagues further; then Tortosa, formerly called Radum, one day's journey distant. To Laodicea is a journey of about three days. For it is about ten leagues to Valania. Others, however, say that from Tortosa to Margat is one day's journey; and from Margat to Laodicea one day's journey, and from Laodicea to Antioch two days' journey. But Antioch is five leagues inland from the sea. From Antioch to Tarsus, made glorious by the Apostle Paul, and the metropolis of Cilicia, is a journey of about three days. It is a journey of one and a half or two days to the borders of Cilicia.

We must now pass to the places inland. Abraham and Isaac frequented the parts of Gerara. For Gerara, from which the region derives its name, as Jerome states in his book on Places, was formerly the limit of the Palestinians between Cades and Sur, and there Beer-sheba is situated, which is called the well of the oath, where Abraham and Isaac made a covenant with Abimelech. From this place the land possessed by the Hebrews begins. They did not possess anything south of this place, as

Jerome states in his letter to Dardanus on the Promised Land; although the land promised them by God began at a torrent in Egypt, as Jerome states in the eighth book, commenting on Isaiah, and in the first book likewise. For that torrent, as Jerome says, is a turbid stream on the borders of Egypt toward Palestine and Judea, which is dry at times. It is not far from the Nile, but is near a stronghold called Rinocorura, which the Seventy Translators have placed in the locality of the torrent, as we find in their translation in Isaiah. From Beer-sheba twenty miles northward is, according to Jerome in his book on Places, Hebron, once the metropolis of the Philistines, but honored as the burial place of four noble patriarchs, namely, Adam the greatest, Abraham, Isaac, and Jacob. It is easy then to turn our attention to the neighboring places, namely, the vale of Mambre and the oak of Abraham and the field of Damascus to the south of Hebron, which is so named from Damascus, a slave of Abraham. Hence this field is not near that great and famous city Damascus, the capital of Syria. For it is distant from that place about five days' journey, but it is near Hebron, where Adam was formed, and where Cain slew his brother, as the Master of the Histories states in his comment on Genesis. Carmel, where Nabal once was, is now the village Carmela by name at the sixth milestone from the town of Hebron to the east, as Jerome says in his book on Places. Near Carmel to the east eight miles from Hebron is the village of Ziph, where David hid, near which is a rugged mountain with the same name, Ziph, on which David abode near Carmela, as Jerome states. Fourteen miles to the east is Bethlehem, the city in which the Lord was born. According to Jerome, six miles from Bethlehem to the north was Jerusalem, the most famous by far of the cities of the East, as Pliny states. This city is distant from Joppa twelve leagues, and from Acon about three days' journey. Jericho is distant eastward from Jerusalem nine leagues. Jericho and the Jordan are distant two leagues. Tekoa, the village of the prophet Amos, is twelve miles distant to the southeast, as Jerome says in the second book on Jeremiah.

According to Jerome in his letter concerning the epitaph of the holy Paula, the region of Pentapolis, containing five accursed cities, Sodom, Gomorrah, and others, was near Tekoa.

For he describes Paula's return from that place to Jerusalem and states that she first passed through Tekoa, which was next to it. Orosius, moreover, in the first book of the Ormesta Mundi states that the region of Pentapolis is situated on the confines of Arabia and Palestine, and that the valley in the middle which the Jordan had watered the sea has now flowed over and covered. This is the Dead Sea and the sea of salt, and is called the sea of salt pits, and the lake of bitumen, and the salt valley, and the valley of salt pits, and the sea of Araba, that is, desert. Whence in the books of the Kings it is written, "From the entrance of Emath as far as the sea of Araba and the sea of Asphalt," that is, bitumen, according to Jerome in his book on Places and in his comment on Genesis. For in the valley of the salt pits were wells of bitumen before the overthrow of the cities, but after the rain of sulphur it was turned into the Dead Sea, which is called the lake of bitumen. Four cities were submerged, and the fifth, which was afterwards called Bale, remained at the prayer of Lot, in order that he might die in it after the destruction of the others. Later it was called Segor, and now in Syriac is called Zoara, as Jerome says in his comment on Genesis and in many places. This city, although it was not consumed with its sister cities by the fire of sulphur, yet after a lapse of time was destroyed by a third earthquake, as Jerome says. It is said to have been restored and called Zoara by the inhabitants, who are called Zoari. This city is at the end of the Dead Sea to the west, from which not far beyond the Dead Sea on the west is the city of Engaddi abounding in palms, whence come balsam and opobalsam. For there is a tree distilling balsam in the vineyards of Engaddi, of which Solomon makes mention in the Canticles. This city is called in Genesis Asasontamar, which in our tongue means city of palms. Tamar means palm, as Jerome states. Although many things are written by many authors on the characteristics of this sea and of the destroyed places, yet I shall here cite chiefly Hegesippus in his fourth book on the Destruction of Jerusalem, because he writes more fully than others, and many of the others have taken their statements from him and narrate them as if they were their own.

Regarding the Dead Sea he says that all living bodies spring back and are ejected at once and cannot be submerged in it;

that the water itself is bitter and sterile, containing no form of life, and finally that it permits the presence of neither fishes nor of birds accustomed to the water and delighting in diving. A lighted lamp, it is said, floats on its waters, and without being overturned is submerged with the extinction of the light, and although submerged with difficulty remains beneath the surface. It is also said that the Emperor Vespasian ordered men ignorant of swimming, with their hands bound, to be cast into the depths, and that they all forthwith floated as though borne up by some spirit of the wind, and when forced down sprang upward with great force. It is certain that lumps of bitumen float to and fro on the waters in a black liquid. These lumps are collected by men approaching in skiffs, who make this their business. Bitumen, it is said, coheres so that it can be cut away in no manner by iron or by any other kind of sharp metal. It yields indeed to the blood of women, who are said to be aided by bitumen in their menses. At the touch of this blood, as those allege who have had experience of its use, the bitumen is reported to be severed. It is said to be serviceable for the seams of ships, and healthful for the human body mixed with medicines. The width in stadia is 150 in the vicinity of the Sodomites, who once inhabited a very fertile region. Four cities, accordingly, were burned, a kind of semblance of which and form are seen in the burnt ruins. The lands burned, the waters burn, in which there still remain the remnants of the celestial fire. You can see there what look like green apples and formed bunches of grapes, so that they produce in the beholders a desire to eat them. If you pluck them, they fall to pieces and are resolved into ashes, and give out smoke as though they were still burning. Whatever, then, Isidore and Solinus state concerning the marvels of the world, and likewise Jerome in his fourteenth book commenting on Jeremiah, and Pliny also and many others, is included in the statement of Hegesippus. For if he summarizes briefly some things, saying that nothing living can be nourished in this sea nor sink in it, the other writers are specific. Pliny and Solinus say that it contains no form of animal life: that bulls and camels float on the water. Jerome says that owing to the bitterness of the water nothing with breath is found in it, whence there are neither fishes nor serpents, but even the fishes carried

down by the floods of the Jordan into this sea at once die. Isidore in his book of Etymologies, explaining the words of Hegesippus, says that it is not stirred by winds, since the bitumen resists the whirlwinds. All the water is made stagnant by the bitumen, and supports no other matter except that in the form of bitumen. The lake extends between Jericho and Zoara, which is Segor.

Since the Jordan flows into the Dead Sea and there loses its name and identity, and since the regions of the Hebrews and many others are identified by means of the Jordan, I must now speak concerning it. Although Jerome speaks in a polished and truthful manner regarding the manifest source and course of the Jordan, also Pliny, Isidore, and others, yet Hegesippus is rightly to be placed before them all, who in his third book explains more definitely and fully the origin of this river. For all authors except Hegesippus, who proceeds by experience, thinks that the Jordan has its origin in two sources at the roots of Mount Lebanon near Paneades, which is now called Caesarea Philippi. Of these sources one is called Jor and the other Dan, which flowing in separate streams at length unite and form the Jordan. For some distance it preserves its identity and then passes into a lake called Gennesareth, to which is contiguous the lake of Tiberias, and then emerging, the Jordan flows to the east of Jericho and empties into the Dead Sea mentioned above.

That whole statement is correct with the exception of that part respecting its origin. Its manifest origin and the one popularly accepted is, as has been stated, from the two sources. But Hegesippus proves that it does not begin there, but from the fountain of Phiala, which is on the other side of Jordan in the region of Traconitis distant 120 stadia from the city of Caesarea. From this source, then, the water flows by subterranean passages and bubbles out again at Caesarea. For Philip, tetrarch of the region of Traconitis, put chaff into the Phiala, which the subterranean stream brought to the surface at Caesarea. Whence it is clear that the origin, not of the Jordan, but of the two branches, is at Caesarea. He adds also, respecting its course, that from Paneades or Caesarea it flows no longer in a hidden and concealed passage through hollows in the earth, but in a visible and open stream through the lands

and beginning to spread out intersects Lake Semeconitum and its marshes. Thence directing its course for 120 stadia it proceeds to a city called Julias. It crosses later the lake called Genessareth, from which, after traversing much desert land, it is received by Lake Alfacius and is lost to sight in it. Therefore leaving the two lakes as a victor it is held fast by a third one.

Now that the Jordan is known, we must describe the cities and regions. The district of Jericho extends to the city of Scythopolis to the north of Jericho, according to Hegesippus. The former city is called in the Bible, Bethsan, as Jerome states in his book on Places, and is a town in the tribe of Manasseh, from which the children of Manasseh were unable to expel the original inhabitants. Westward and to the north of Jerusalem is the priestly city noted as the birthplace of the prophet Jeremiah, which is called Anathoth, distant three miles from Jerusalem, as Jerome states in his fifth book on Jeremiah. Thence more to the north, twelve leagues from Jerusalem and twelve miles from Caesarea in Palestine in the direction of Caesarea, is the famous city of Samaria, the metropolis of the ten tribes, which is now called Sebaste. Moreover, beyond the region of Caesarea in Palestine from the great sea to the boundaries of the Ptolemaean region is Mount Carmel extending in length about two days' journey, on which the prophet Elijah prayed, thickly covered with olive trees, orchards, and vineyards, as Jerome states in the fifth book, and in the first in commenting on Jeremiah. After the district of Samaria to the northeast comes the plain of Saba, so named at the present time, but anciently called the great field of Estrelon, mentioned in Judith, chapter I. The plain of Megiddo follows, in which excellent King Josiah was slain.* And through its borders to the north flows the torrent Fison to the great sea between Caiphas and Acon. Then to the north of that plain and distant seven leagues eastward from Acon is Nazareth, blessed city of our Lord Savior. Then two leagues further to the east is glorious Mount Tabor, on which the Lord showed his glory to his three disciples and Moses and Elias.

Then to the east is the city of Tiberias, which in ancient times was called Cenereth, as Jerome states in his fourteenth

* A hiatus occurs here in all the MSS.

book on Ezekiel, and near this the sea of Tiberias, also called the Lake of Cenereth, on which the city is located, which, according to Isidore in the thirteenth book, "is more healthful than all other waters of Judea, and is 160 stadia in circuit, which the lake of Gennesareth joins, the largest of the lakes in Judea. It extends in length 160 stadia, in width 40 stadia, the waters of which are unruffled by the winds with their blasts, but the lake ruffles itself, whence also Gennesareth is called by a Greek name indicating that the lake produces its own blasts of wind. Then through more extended spaces it is roughened by frequent gusts. For this reason its waters are purer and sweet and fit for drinking." These are the statements of Isidore, who distinguishes these lakes by their size and natural quality, although the gloss on Matthew VI says that the same lake is called the lake of Gennesareth and the sea of Tiberias and the lake of salt pits. But the lake of salt pits, according to all authorities, as stated above, is called the Dead Sea, and therefore this gloss of the master was based more on rumor regarding the places than on authority of the sacred writers or on experience. The statement, however, that the sea of Tiberias and Lake Gennesareth are one can be referred to their vicinity. For they are contiguous and join, and for this reason are reckoned as one. The Gospel of John shows that they are different lakes, because it states in the sixth chapter that Jesus went away across the sea of Galilee, which is the sea of Tiberias, and then came to the desert of Bethsaida according to Luke; and later the disciples came to Bethsaida according to Mark; then they put to sea that they might go to Capernaum, according to John. This cannot properly be the sea of Tiberias because they had crossed it before. This is therefore the sea of Gennesareth, and hence they are distinct but adjoining bodies of water. Then toward the north with the desert between, in which our Lord fed the five thousand from five barley loaves and two fishes, is Bethsaida, the city of the prince of the Apostles and of Andrew and Philip. Then comes Capernaum. It is clear from the Gospels that this is the order of those places. For before the miracle of the loaves, John says, Jesus went away across the sea of Galilee which is the sea of Tiberias; and then the multitude he fed met him; and after this the disciples went aboard ship, in order that they might cross to Caper-

naum, as John says, but before they arrived there, and before he fed the multitude, he came to a desert place, which is Bethsaida, with his disciples, as Luke states. Mark also states that they came to Bethsaida. Wherefore first is Tiberias, then beyond the sea of Tiberias toward the north is the desert of Bethsaida, and near it is Bethsaida, and then the lake of Gennesareth and finally Capernaum on its shore. All these facts are shown in the large gloss on the sixth chapter of Mark. Then after Capernaum is Julias, a town of which mention was made above; then Caesarea Philippi, at the foot of Mount Lebanon.

Further from Acon than Nazareth is Cana of Galilee, in which the Lord changed water into wine. Cana is distant from Acon five leagues. The distance from Cana to Nazareth is two leagues. Moreover, from Acon to the northeast nine leagues is Sapheth, the city of Tobias, about five leagues beyond Cana. Then at the distance of a league and a half is the city of Corazaim, distant from Tiberias about two leagues. In these places, Tiberias, Bethsaida, Corazaim, Capernaum, Cana, and Nazareth, the Lord spent most of his time preaching and doing miracles, as the Gospels state. The Lebanon range extends from Paneades or Caesarea from the region of Tyre, and Sidon, and Baruch, and Biblium, and Tripolis for a thousand and fifty stadia, as Pliny says, and opposite Tyre water flows down from Lebanon underground, and runs near Tyre for a league, and there bursts forth into a very wide well and like a tower in depth, which passes by means of a canal into the country and irrigates the neighboring localities. This well is the well of living waters which flows from Lebanon with force, of which mention is made in the Canticles. Moreover, opposite Tripolis is a fountain of gardens near the hills of Lebanon, flowing as far as a foreign mountain, from which a river flows and empties into the sea between Tripolis and Tortosa, yet near Tripolis. From that same fountain of foreign origin runs an aqueduct into Tripolis. The fountain of gardens and Lebanon are distant from Tripolis three leagues. Sidon is distant from the hills of Lebanon about three leagues, from the great mountain about five leagues.

Since now the cities and mountains this side of the Jordan and toward our sea have been discussed, we can now add some

places toward the Euphrates. First beyond the Dead Sea is Macheron, formerly a stronghold second to Jerusalem, as Pliny states, at which the tribe of Reuben begins to the south; and in the north beyond Jordan near Mount Lebanon is the city of Pella, which is the farthest limit of the land of the Hebrews beyond Jordan in the north near Caesarea Philippi. According to Jerome in his book on Places the limit of that land to the east is the city of Philadelphia, which is called in the Bible Rabath of the children of Amon. On the boundary of the kingdom of Sehon and of Og, king of Basan, is Jacob's stream, as has been mentioned, where Ramoth-Gilead is located, of which frequent mention is made in the wars of the kings of Israel. Near Pella and Caesarea Philippi is Mount Hermon, towering above Caesarea and over against Lebanon to the east of the land of the children of Israel, as Jerome says in his book on Places, from which snows in summer are brought to Tyre as a luxury. But, as Pliny states, behind Lebanon with a valley lying between there rises a range of mountains equal to Lebanon, which is called Anti-Lebanon, and is situated toward the eastern part of Mount Lebanon, as Jerome states in his book on Places. Mount Galaad, according to Jerome in his book on Places, at the boundary of Phoenicia and Arabia joins the hills of Lebanon to the south, and extends through the desert to that place where, across the Jordan Sehon, king of the Ammonites, once dwelt. This mountain fell to the lot of the tribes of Reuben and Gad and the half-tribe of Manasseh. Jeremiah says, "Galaad, thou art to me the head or beginning of Lebanon." Anti-Lebanon extends, according to Jerome in his book on Places, around the regions of the city of Damascus, which fell to the lot of the tribe of Manasseh, and is the Damascus called in the books of the Kings the capital of Syria, which is distant from Jerusalem about four days' journey, from Acon about three, from Tripolis about two, from Baruch one. Then from Damascus about a seven or eight days' journey to the north is the famous city of Alap, which in ancient times was the abode of Abraham, distant from the Euphrates about two days' journey and from Antioch a journey of a day and a half. Then at the end of the promised land to the north in the east is the city of Amath, as mentioned in Numbers, chapter XXXIV, in the second book of Kings, chapter VIII, in the

first book of the Apocrypha, and in many other places. Jerome says in his book on Places that he inquired diligently regarding this city and found that it is called Epiphania. Then comes the city of Comaga near Cilicia, where glowing fossil tar is found, which if cast on an armed soldier burns him up, nor can it be extinguished by water nor by any other liquid, but must be put out by placing earth on it. For a long time was the Roman army disturbed and confused by this bitumen cast upon its soldiers, until they learned the expedient of casting dust on the place touched by the bitumen. Pliny states this fact in his second book.

After the cities, mountains, bodies of water, and other particular places have been given, the provinces and regions near these can now more easily be considered. This whole Syria this side of the Euphrates is of immense length, but is narrower in width, as Isidore states. Pliny says that its length from Cilicia to Arabia is 470 miles; it has, moreover, many provinces all bearing the name of Syria. For in it are Syria-Comagena, Syria-Coele, Phoenician-Syria, Palestinian Syria, Galilee, Samaria, Judea. For these regions belong to Palestinian Syria, according to the authorities. Syria-Comagena, as Isidore states in his fourteenth book, is called from the name of the city Comage, which was once considered the metropolis in that region. This province has the Euphrates on the east, Cilicia and Cappadocia on the north, our sea on the west, Syria-Coele on the south, which is written with the diphthong, and is called Coele-Syria. Its capital and chief city is Antioch in the west, with which on the sea are connected Laodicea, Ateradum, and neighboring states as far as the province of Phoenicia, and in the east is Emath. For Jerome says in his book on Places that investigating diligently he found that this city of Emath was in Coele-Syria, and Pliny states this fact. So also is Alap, which is near Antioch and far distant from Damascus, which is in Phoenician Syria. This province has then on the west the great sea, on the north Syria-Comagena, on the east the Euphrates, on the south Phoenician Syria, which begins at the northern terminus of Mount Lebanon. For Pliny says that this range extends to Coele-Syria and this is around Tripolis; in this division are Tripolis, Tyre, Sidon, and Acon as far as Caesarea in Palestine.

For Pliny says that on the coast of Phoenicia is Ptolemais, which is called Acon, and Caesarea Philippi is in the province of Phoenicia, as Jerome states, and all this side of the Jordan as far as Palestine; and it contains Mount Lebanon and Anti-Lebanon and Damascus with its region, and all beyond Jordan to Pella, Mount Hermon, and Mount Gilead and those lands of the children of Israel beyond Jordan. That Damascus is in Phoenician Syria is manifest. For Jerome says in his book on Places, Damascus is a famous city of Phoenicia; and in his comment on Genesis he includes Damascus in Phoenician Syria, when he states that Hus, son of Aran, possessed Damascus and as far as Coele-Syria. The chief cities, however, of the Phoenicians are Tyre and Sidon. For, as Isidore states in the fourteenth book, Phoenix, brother of Cadmus, coming from Thebes in Egypt to Syria, reigned about Sidon, and called this province Phoenicia from his own name. This people likewise founded Tyre, from whom the whole land is called Phoenicia. This, however, is divided into two main parts, namely, the region of the Tyrians, Syrians, Aconensians, and the whole country between Lebanon and Tripolis; and the other main part is the Syria of Damascus. The city of Damascus as far as respects the kingdom of Syria between the Euphrates and Mount Lebanon was called the capital of Syria. For the name of Syria in the time of the kings of Israel was given to Damascus and its region. This province, therefore, of Phoenician Syria has the land of the Hebrews to the south and the land of the Philistines; but the land of the Philistines begins at the confines of the territory of Acon as far as the turbid stream of Egypt, and in ancient times contained nearly the whole country of the Jews this side of Jordan.

Since, however, the Jews occupied much of the region of the Philistines and shut them up in their maritime cities, namely, Caesarea, Joppa, Ascalon, Gaza, and others; we must therefore here note that this side of the Jordan there are three principal regions of the Jews, namely, Galilee, Samaria, and Judea named in a special sense, as stated in the gloss on Matthew XIX. The whole province of the Jews to distinguish it from other nations is called Judea, but in a special sense the southern district is so named to distinguish it from Samaria, Galilee, Decapolis, and other regions of the same province.

Moreover, this whole country of the Jews across Jordan and on this side Josephus in his book of Antiquities divides into parts and arranges, whom Hegesippus has followed in his third book, and explains those matters which are found somewhat obscure in Josephus. By these writers the whole region across the Jordan is called Pera. Its length is from Macheron beyond the Dead Sea to Pella near Caesarea Philippi and Mount Hermon, its width from Philadelphia to the Jordan. We find two main divisions in it; one is Decapolis, containing ten cities, of which one is Pella, as Pliny says, and the others connected with it to the south of Lebanon and Anti-Lebanon, according to Pliny, toward Philadelphia, which, as he says, two tetrarchies surround, namely, Paneas or Caesarea Philippi on the west and the region of Traconitis to the south beyond Jordan. Therefore this Decapolis is near Lebanon and Caesarea Philippi, and joins the territories of Tyre and Sidon, as Mark states in chapter VIII, "Jesus departing from the coasts of Tyre came through Sidon unto the sea of Galilee through the midst of the coasts of Decapolis." After this division to the south beyond Jordan is Ithuraea or the tetrarchy of Traconitis, in which is Phiala, the source of the Jordan, as has been stated above, not far distant from Caesarea, and also the region of the Geraseni, whose capital is Gerasa. The gloss on Mark, chapter V, says, Gerasa is a city of Arabia across the Jordan, adjoining Mount Gilead in the tribe of Manasseh not far from the lake of Tiberias, into which the swine rushed. Here, therefore, dwelt the Geraseni or Gergasenes, as we learn from this place. Then toward the south is another part of Ithuraea or of the region of Traconitis, of which Jerome speaks in his book on Places. The region of Traconitis or Ithuraea, of which Philip was tetrarch, according to the Gospel of Luke, is beyond Bosra, a city of Arabia, in the desert facing the south, and to the north it looks toward Damascus. This Bosra is in the desert beyond the Jordan, which fell to the tribe of Reuben to the south of Jericho and extends toward Macheron and the confines of the Moabites. But that there may be no question about Bosra, it must be stated that there is another city of this name in Idumaea, of which Isaiah says, "Who is this who comes from Edom, with dyed garments from Bosra?" as Jerome points out in his book on Places. Moreover, that Ithu-

raea extends almost to Decapolis and Caesarea is clear from the statement of Pliny that Ithuraea surrounds Decapolis.

The regions this side of the Jordan are thus divided. For according to Josephus and Hegesippus first there is entire Galilee, which has to the north the confines of Tyre and Sidon, to the west the territory of Acon with Mount Carmel, to the east Decapolis, to the south Samaria and Scythopolis given above. Galilee, however, has two divisions, the upper one being that of the Gentiles, which adjoins the territories of Tyre and Sidon. This, therefore, is called Galilee of the Gentiles, because Solomon gave to Hiram, king of Tyre, twenty cities in it. Therefore since Gentiles in this Galilee have mixed with the Jews, and because it is near nations of Gentiles to the north and to the east and to the west, it is called Galilee of the Gentiles. This ends near Tiberias and below the great plain of Esdrelon. In these places begins lower Galilee, called Galilee of the Jews, which is in the tribe of Zebulun. But we must be careful not to think that it is across the Jordan, as many have done owing to the statement of Isaiah and the Gospel of Matthew, "The land of Zebulun and the land of Nepthalim by the way of the sea across Jordan, Galilee of the Gentiles." But the gloss on Matthew says, Galilee of the Gentiles which is in the tribe of Nepthalim bordering on the Tyrians; and therefore since the tribe of Nepthalim is this side of Jordan, this Galilee is also. Jerome states this fact in his book on Places; and Josephus, Hegesippus, and all others attest it. But we must consider the form of expression in this matter. For we frequently find this form of expression in the Gospels. In the sixth chapter of Mark it is said, "And they departed into a desert place by ship. And the people saw them departing, and many knew him and ran afoot thither out of all cities, and outwent them and came together unto him." Where the gloss says, Jesus and his disciples did go to the other bank of the lake or of the Jordan, but crossed some sound or arm of the lake, and the inhabitants came to the neighboring localities, which they could reach on foot. From this we learn that across Jordan here means to pass over some portion of it, not the whole river. In the same way when it is said in the sixth chapter of John, "After these things Jesus departed across the sea of Galilee, which is the sea of Tiberias," he did not cross to the other shore,

where the country of the Gergasenes is situated, but crossed an arm of the lake on the same side, namely, this side of Jordan, and therefore in this passage as in the one above a part is put instead of the whole. And when in the same chapter the evangelist says, "They came across the sea to Capernaum," they were still in the same region and were always this side of Jordan. Therefore the whole sea is not understood, nor is there a crossing to the other shore, but the part is understood instead of the whole on the same side of Jordan; and so here when it is said across the Jordan, Galilee of the Gentiles, a part is taken instead of the whole. For from the place where Isaiah said these things there was a long distance on the Jordan to Galilee of the Gentiles, which must be crossed in going from the one place to the other, and therefore he says across the Jordan, that is, across a great part of the Jordan which extended from Isaiah's locality to upper Galilee. Then to the south of Galilee of the Jews is Samaria, which is not only the name of a city but of a district, beginning in the great plain and extending to Judaea. The width of Judaea is from the Jordan to Joppa, according to Josephus and Hegesippus, and its length extends to Beer-sheba.

Now finally we must settle the question of the size of the promised land and the amount of it possessed by the Jews. But Jerome determines this matter definitely in his letter on the land of promise, saying that neither David nor Solomon ever possessed the land except from Dan to Beer-sheba, although after their victory they received many enemies and tributaries. The length of the land between Dan and Beer-sheba is scarcely 160 miles, as he himself states and infers. It is a shame to mention its breadth, for from Joppa to our little village of Bethlehem the distance is forty-six miles, and from Bethlehem to the Jordan about one day's journey. Hence the portion possessed by the Jews was small. We must bear in mind, however, that the portion just discussed was only their possession this side of Jordan.

Two tribes and a half-tribe, it is evident, had their possessions beyond the river, as Jerome explains in this letter. But the land promised them was from the Euphrates on the east to our sea on the west, and from Cilicia and the Taurus range on the north to the turbid river of Egypt, and to the land of Edom,

and of Moab, and of Ammon on the south. For in his eighth book Jerome says, commenting on Isaiah, that the country from the Euphrates to the river of Egypt was promised to the Jews, nay, as far as the Nile. For that river is near the Nile. The Euphrates is to the east of this land. Moreover, the river of Egypt with our sea, into which it empties, is to the west. In his first book also he makes this same statement. He adds that on the north the land was promised them from Cilicia and Mount Taurus, and in the fourteenth book on Ezekiel he says the northern region begins at our sea stretching as far as Zephirus, a town of Cilicia, and to the very lofty Taurus range, and to Emath, a city of Coele-Syria now called Epiphania, and in the west continues from the torrent of the city of Rincocura flowing into the great sea, to that point on the sea opposite Emath, a city of Syria, of which mention was made above. The southern part begins at the torrent of Egypt, where it falls into the great sea, ascending through the desert of Sin and of Cades, and through the land of Edom, of Moab, and of Ammon, as far as the Euphrates. For if the Euphrates is in the east, and the sea into which the river of Egypt falls is in the west, then the southern part extends between that sea and the Euphrates. This follows of necessity. But this fact does not rest on a single authority, but is verified from many sources and follows from what has been said. For since in chapter XXXIV of Numbers and in the fourteenth book on Ezekiel in many places it is stated that the sea of Cenereth and the Jordan and the like are in the east, this fact is established with respect to the land possessed by the Jews this side of the Jordan. But beyond Jordan they possessed much, as is clear in the case of the two tribes and the half-tribe, and more was promised them, since the land promised reached to the Euphrates.

In the middle of Judaea is Jerusalem, rich in varied resources, whence, thanks to the elements, the Jews thought this the promised land flowing with milk and honey, since God from this source promises them the privilege of the resurrection. The separation of the ten tribes gave the Jews their name, for before that they were called Hebrews or Israel. But from the time when the people of God was divided into two kingdoms, the two tribes which had kings from the stock of Judah

have been called Jews. The remaining ten tribes which appointed a king for themselves in Samaria were called Israel.

In considering other regions we must describe the Taurus range, since it separates countless regions. It begins in the east at the Indian sea and crosses to the west through the confines of India and the kingdoms of the Parthians, and through Mesopotamia and Syria. It leaves these provinces toward the south, and to the north the whole region of the Scythians and part of greater Armenia and Cappadocia, and crosses into Cilicia. In different regions it bears different names. For sometimes it is called the Caucasus, where it is higher, because of the abundance of its snows, for in the tongue of those people over whom it towers Caucasus means dazzling white, in another locality it is called the Caspian range, in still another the Taurus, and sometimes the Hyrcanus; and by many other names, more than twenty in number according to Pliny. For it has eight names from the Indian Ocean in the east before it is called by its own name, Taurus, then Caucasus, and after that it takes three foreign names, and is again called Taurus. But where it opens and the Caspian gates are formed, it is called the Caspian and Hyrcanus, and by many other names, concerning which we need not bother at present. These are Pliny's statements, although Orosius differs, and many others are at variance with the latter. Whence that whole range is called by many the Caucasus in the direction of India and then the Taurus. Others reverse these names, but we need not care since the different ideas and the different names in this case refer to the same thing. The more common practice of learned geographers is to call the range the Caucasus in the east, then the Caspian or Hyrcanus, after that the Taurus, and again the Caucasus, since where it reaches its greatest height it is called Caucasus, and then again the Taurus. The whole range is also called the Caucasus, and the whole is called the Taurus, following different views.

We must return then to the eastern regions beyond Mesopotamia, Assyria, and Babylonia, and state according to Pliny and all others that in that region are the kingdoms of the Medes and Persians and of the Parthians. These kingdoms have on the west the Tigris River, on the east the Indus River, on the south the Persian Sea or the Persian Gulf of the Red

Sea, on the north Armenia and the Taurus and Caucasus mountains, and the Caspian gates, or the Hyrcanian, and the land of the Hyrcanians and the Hyrcanian Sea, which is the Caspian. For the Caspian is the same as the Hyrcanian Sea, as Pliny states. We understand that the kingdoms of the Persians now belong to the Parthians, as Pliny states. Yet in fact that part which is on the Persian Sea is near Persia; for from it the Persian Sea is named. For there are eighteen kingdoms of the Parthians, as he states. Eleven are called upper and northern, which begin at the confines of Armenia and the shores of the Caspian or Hyrcanian Sea, and these peoples are properly Parthians, and extend to the Scythians, with whom they live on terms of equality. The Scythians dwell in the regions of the Caspian or Hyrcanian Sea and mountains. The other seven kingdoms of the Parthians are to the south, and adjoin the Persian Sea, and are properly called kingdoms of the Persians, and those people are Elamites, that is, princes of Persia, as Jerome states on Genesis and in his book on Places. For Elam is the chief city of the Persians, in which was Susis or the fortress of Susa, of which mention is made in the eighth chapter of Daniel, where was located the capital of the kingdom of the Persians. Pliny states that near the Tigris and 250 miles from the Persian Sea is Susa, capital of the Persians, founded by Darius, son of Hystaspes, on the northern channel of the Tigris. Near there is the town where the inhabitants unlike all other mortals cause gold to be hated, and dig it in order that no one may use it. The Medes are neighbors of both the Parthians and the Persians. For one part of the Medes, namely, that in the north, is next to the Parthians and Caspians, and begins directly at the Caspian Gates and on the confines of Armenia. Therefore they have the Parthians to the east, and to the north Armenia and the Caspian gates, to the west the Tigris, because the Parthians are beyond them toward the Indus River. The southern part of the Medes turns between the upper and lower kingdoms of the Parthians, so that it has the lower kingdom of Persia not directly to the east, but more to the south tending toward the west, according to the view of Pliny. For Media includes both the kingdoms of the Persians and embraces them, according to Pliny.

Beyond the Indus River toward the east is the whole of

India as far as the Scythian Sea, which is to the north, and the Himanus, Hemodus, and many other mountains which are parts of the Caucasus; and extends to the Mare Eoum, which is the sea in the east, and to the Indian Sea in the south, into which empties the Indus River, as Pliny states, because the Red Sea has now disappeared. Hence India has the Indus River on the west, and the kingdoms of the Persians and Medes; and it has the Scythian Sea, the Caucasus and Taurus mountains on the north and the kingdoms of the Scythians, and the Indian Sea to the south, and the Mare Eoum to the east, the configuration of which at the beginning was touched upon in many places, because there begins the habitable world. Therefore we had to begin with this country that the pen might proceed on through the longitude of the habitable world to the west through the regions of the Aethiopians, and again return from the west according to longitude.

The regions succeeding the former ones have been discussed as far as India, of which some things must still be said. For it has very great rivers, among which especially are the Indus and the Ganges, of which Scripture speaks. Regarding the size of the Indus Pliny says Alexander the Great on no day sailed less than 600 stadia on the Indus, nor was he able to sail over the whole of it before five months with the addition of some days. Yet the Ganges is greater, as he says; and this river, as Scripture states, compasseth the whole land of Havilah, where there is excellent gold. For rising in the mountains of the Caucasus in the north it divides India, flowing to the east, where are situated its great mouths at which it disappears in the Mare Eoum, that is, the sea in the east.

The Brahmins, of whom mention is made in the epistle of Jerome prefixed to the Bible, are in India. Because the sacred writers and philosophers and the histories relate more wonderful things about them than about other races, I shall here insert something about them, and in particular I shall cite what I wish from the writings of the blessed Ambrose for greater certainty. He states then in his letter to Palladius on the life of the Brahmins that they dwell by the river Ganges, where it flows into the Mare Eoum, but the men dwell beyond the river toward the sea, and the women on this side because of their remarkable chastity. For only because of their desire for

offspring do the men consort with the women at certain times, namely, July and August, as the aforesaid sacred writer states. But when they have completed forty days with their women, they then return to their own abodes. When the wife of a Brahmin has travailed and brought forth a first and a second child, her husband does not cross again to her, for the sons one at a time take their fathers' place and the fathers refrain from intercourse of this nature for the rest of their lives. If, however, it happens that any one selects a barren wife, he crosses to her and sleeps with her for five years, and if she does not become pregnant at all within that period, he then abstains altogether from her. As it appears from this letter and from the principal work written by the blessed Ambrose on the life of the Brahmins, they have a very temperate climate, so that they do not use garments but cover themselves with the leaves of trees. They do not cultivate their lands, nor do they have trees or bread or wine; but they live on plants and leaves and fruits growing without cultivation, and they slake their thirst with their excellent waters. They are healthy without infirmity and live to a great age.

North of India, as has been said, are the Scythian Sea and those great mountains which are called Caucasus and Taurus and by many other names according to the diversity of places and races. To the west is Persia or Parthia, and Media. Then next them to the west is Mesopotamia and all Syria, as has been said. But on the confines of Media and Parthia is the iron gate of Alexander, which is a city named from the gates, and these gates are called the Caspian gates, not the Caucasian, as Pliny states. For the gates of Caucasus are different ones, as will be stated later, because these gates are on the shore of the Caspian Sea. For there is a certain sea, which is formed from the union of very great rivers flowing from the north and is called the Caspian Sea and the Hyrcanian Sea, according to Pliny. For the Caspii and the Hyrcanii dwell on the shores of that sea; nor does this sea enter from the ocean, as Isidore and Pliny and all other authors write. For in this case they did not have definite experience, either personal or through others, but wrote from hearsay. But in books on the manners of the Tartars and by men worthy of belief who have been in those regions, it is made clear that this sea is formed from the union of rivers, and

is quite large. For a journey round it requires four months. Hyrcania is near at hand beyond the southern shore of that sea on the confines of Parthia; and where Parthia joins Media at its gates, extends from the Caspian gates toward the east, as Pliny states; then facing the remainder of Media to its north and to the west of Hyrcania is greater Armenia, divided by the Euphrates from Cappadocia, as Pliny states, wherefore Cappadocia is to the west of greater Armenia.

Then toward Syria and our sea is Cilicia, which is called lesser Armenia. Hence it lies partly south, partly west, of Cappadocia and begins less than a journey of two days from Antioch. Comprised under Cilicia to the north on the sea is Pamphylia, as Pliny states. The Isaurian tribe is passed over or not counted separately because of its small size, and is included with these states. In Cilicia is Tarsus its metropolis in which the blessed Apostle Paul was born. Cilicia extends from the south northward through Tarsus in width about four days' march toward Turkia; for to the north of Cilicia is Lycaonia, where is Iconium a very noted city, from which Lycaonia is designated as Iconia. Hence the ruler is called the sultan of Iconium and Turkia, for Lyconia is now called Turkia. From the confines of Armenia to Iconium is a journey of eight days. The names of provinces in these regions have been much changed owing to wars. For Turkia occupies many lands, which have ancient names in the authors, such as part of Asia Minor, Phrygia, and Lydia. Asia Major contains more than half of the world and all except Europe and Africa, and hence includes Asia Minor. Asia Minor is now called among the Greeks Anatolia, that is Eastern Greece, in which is Galatia, whence the Galatians to whom the Apostle writes, and Ilium, also called Troy, that very famous city. And there are many others, as Ephesus, and the seven churches of the Apocalypse, and Nicaea, whence the Council of Nice, and many other cities. In summer it is a journey of twenty days from Iconium to Nicaea; and from it to the Arm of Saint George, called by the ancients the Hellespont, is a journey of about seven days. This arm extends from the sea between Italy and Antioch. There Asia Minor terminates on the west. On the south it has that sea which is between Italy and Greece and Antioch and Egypt. To the east it has Phrygia. For, as Pliny says with reference to the divisions, Phrygia,

situated above Troas, on its northern side joins Galatia, on its southern side Lycaonia, and to the east has Cappadocia. He also states that Lydia joins Phrygia on the east, whence came Croesus, a very rich king of the Lydians. The Arm of St. George is very narrow and has Constantinople on the west in Europe, and extends from the great sea between Asia, Egypt, Syria, and Italy, about one hundred leagues to the north to that sea which is called Pontic, and greater sea. That sea has the shape of a Scythian bow, and separates many regions.

Hence the regions of the north begin here, of which southern philosophers have little knowledge, as the astronomer Ethicus states in his book; but he traveled over all these regions and sailed the northern ocean with its islands. I wish, therefore, to follow him and also the books on the manners of the Tartars and particularly Friar William, whom the lord king of France, Louis, then in Syria, sent to the land of the Tartars in the year of our Lord 1253. Friar William wrote to the king of the location of the regions and seas.

This greater sea extends in length from the west, namely, from Constantinople, eastward for 1400 miles, and at its middle on both sides contracts into bays, and on the southern bay is the stronghold and port of the sultan of Turkia which is called Sinopolis. On the northern side he has another stronghold on a bay. This place is called Soldaia, and is in a province now called Cassaria or Cessaria. It is 300 miles from Sinopolis to Soldaia, the width of the sea between those bays. These strongholds are two famous ports, from which men cross from the regions in the south to those in the north and vice versa. From those strongholds toward the west or Constantinople the sea extends 700 miles in length and in width, similarly to the east 700 miles. This province of Cassaria is surrounded by the sea on three sides. For on the west it has that part of the Pontic Sea where is situated the city of Kersona, in which Saint Clemens became a martyr. Near it is an island, on which is a temple said to have been built by angelic hands, in which the body of the saint was buried. From Kersona to Soldaia there are 400 settlements, nearly every one of which has its own dialect. There are many Goths in that region, all of whom speak the Teutonic language.

The Pontic Sea extends from the southern part of Cessaria,

and to the east of it empties the river Tanais into the sea where it has a width of twelve miles. Here is located the city of Matrica. This river toward the north forms a sea of 700 miles in length and width, with a depth nowhere exceeding six feet. This sea is the very famous lake of Maeotis, of which philosophers, the histories, and poets speak. The river Tanais extends beyond that lake toward the north to the Riphaean mountains, which are in the extreme north. This river rises in these mountains and flows down through a vast stretch of country into the aforesaid lake, which it forms. The river then leaves this lake and flows into the Pontic Sea, as I stated above. This famous river divides Europe from Asia in those parts, and the lake mentioned and many others are contiguous, but are reckoned as one; and are called the lakes of Maeotis, or Maeotic in adjectival form. Those swamps then which bear the name of that shallow sea are in the east of Cassaria, and are part of the river Tanais, which is between the marshes and the Pontic Sea.

This province of Cassaria has on the north a vast desert, extending from the river Tanais in the east as far as the Danube in the west, a journey of two months if made swiftly on horseback, at the rate at which the Tartars ride, who cover a distance equal to that from Orleans to Paris in a single day. Hence this land extends for a distance equivalent to a journey of about four months as other men generally ride. This land belonged wholly to the Cumani, who were called Captac, but the Tartars destroyed it completely and slew the Cumani except the part which fled to the kingdom of Hungary, becoming tributary to it. This tribe is called Volana by the Teutons, but Alania to the west by Pliny, Isidore, and others. This province has the Danube, Poland, and Hungaria to the east.

On the north of this province is Great Russia, which likewise extends from Poland on its one side to the Tanais; but on its great side has Leuconia on the west, which is a land as large as Alemannia. On the western side of this country are many lands in the circuit of a sea, formed by many arms of the ocean which enter through the middle of Dacia; and beyond this country it widens into a great sea which on the west has Dacia and Sweden. Sweden is to the north of Dacia, sloping somewhat to the east beyond Dacia. Beyond these lands to the

north is Norway. Then across a great intervening sea are Scotland and England and, separated by a small sea, Ireland. These regions are known, but I touch upon them to give a notion of the others. If then from the limits to the west we go on the north toward the east, first comes Ireland, second Greater Britain, containing England and Scotland, then Norway, Sweden, and Dacia. After these toward the east is the great sea mentioned above, called the Eastern Sea, because the ocean does not extend beyond that sea. But beyond the northern side of that sea is Esthonia; then Livonia toward the east of that sea; then Curonia or Curlandia as we pass to the southern side; after that Prussia, a large country, on the southern side; then Pomerania; after that Lubec, a great and famous port on the confines of Dacia and Saxonia. In the middle of that sea is an island called Gothland. Beyond Livonia to the east is Semi-Gallia. These lands, namely, Esthonia, Livonia, Semi-Gallia, Curonia, are surrounded by Leucovia mentioned above and it is surrounded by Great Russia on both sides of the aforesaid sea. Russia terminates to the south at Prussia and Poland. Poland lies to the south of Prussia, and to the south of it is Bohemia, then Austria. To the west of these lands is Germany, and then France and Spain. But these countries are known, yet I mention them on account of the others. To the east of Austria and Bohemia is Hungary, to which the western part of Albania extends. For it lies beyond the Danube, which flows through the middle of Hungary and beyond it into the Pontic Sea by twelve great mouths. At the end of eastern Hungary on the north is Albania, opposite which to the south of the Danube are the Blachi and the Bulgari and Constantinople, lands that were called in ancient times Thrace. Albania, therefore, to the west extends from the Danube after the limit of Hungary toward the east, as far as the river Tanais, with Cassaria on the south and Blachia, Bulgaria, and Constantinople; on the west Hungary, Poland, and the extremity of Russia; on the north it has the whole length of Russia.

Beyond Russia to the north is the Hyperborean race, so named from great mountains called Hyperborean. This race, owing to the healthfulness of the climate, lives in the woods, a race long-lived to a degree that they disdain death, of excel-

lent habits, quiet and peaceful, harming no one and molested by no other nation. But others flee to this race as to a refuge. How it is possible for this region to be very temperate, I explained previously in treating of the characteristics of the localities of the world. Thus we have before us the notable northern regions in Europe. The rites of these races are of different kinds. For the Pruseni, Curlandi, Livonii, Estonii, Semi-Galli, and Lencovi are pagans. The Alani no longer exist, because the Tartars invaded that country and drove the Cumani to Hungary. The Cumani are pagans, so likewise were the Alani, but they have been destroyed. The Rusceni are Christians but schismatics following the Greek rite, but they do not speak the Greek tongue but the Sclavonian, which is one of the tongues spoken in many regions. For it is the language of Russia, Poland, Bohemia, and of many other nations. The Tartars inhabit the land of the Alani or Cumani from the Danube almost to the remotest parts of the east; and the other nations bordering on them to the north and south have they subjugated for the most part. For some tribes are in the mountains in very well-protected places which they are unable to conquer, although these tribes are their neighbors, because they are unconquerable.

The Tanais River flows down from the very lofty Riphaean mountains in the north, nor is there any habitation beyond them to the north. At the end of Russia and Alania, where congregate merchants and others who have come from Hungary, Cassaria, Poland, and Russia, there is a village, where the river Tanais is crossed by boat. The Tanais at that place is about the width of the Seine at Paris. Beyond that river is upper Albania as far as another great river called the Ethilia, four times larger than the Seine, and one of the larger rivers of the world, swelling in summer like the Nile. To the north this river is distant from the Tanais ten days' march, but toward the south they are far apart. For the Tanais falls into the Pontic Sea, and the Ethilia into the Caspian, and with many other rivers forms this sea. These rivers flow from Persia and from other localities. For the Pontic Sea, according to Pliny, is distant 380 miles from the Caspian.

In this land dwelt the Cumani, but the Tartars destroyed them all, just as they did on the other side of the Tanais as far

as the Danube, as has been stated. The Tartars have countless herds of cattle and dwell in tents, having neither houses nor fortified places except very rarely. One chief with his army and his herds roams between the rivers, as, for example, between the Danube and the Tanais, and a second chief between the Tanais and the Ethilia, and so on eastward, because they have always been divided by the pastures and the waters. From January they begin to travel to the northern parts within the rivers until August, and then they return toward the south on account of the cold in winter. Toward the north the Ethilia is distant from the province of Cassaria one month and three days as the Tartars ride.

This land of the Tartars has between the Tanais and the Ethilia certain tribes to the north. First is the Arumphean tribe near the Riphaean mountains, which is similar in all respects to the Hyperboreans. These two tribes are near the pole in the north; but not so far north beyond the Tanais there is first a tribe called Moxel, subject to the Tartars. They are still purely pagan without law; they have no city but inhabit huts in the forests. Their chief and many of them were slain in Poland by the Poles, Alemanni, and Bohemians. For the Tartars led them to war with the Poles. They strongly favor the Poles and the Germans, still hoping to be freed by them from the Tartar yoke. If a trader comes among them he must give to the master of the first house in which he is entertained his expenses for the whole time he expects to remain there. For this is the custom of that region. Next to these eastward is a tribe called Merduim, subject to the Tartars. They are Saracens, following the law of Mahomet. After these comes the Ethilia, a river before mentioned, which flows down from greater Bulgaria, a land of which mention will be made later.

To the south of this land of the Tartars beyond the Pontic Sea are the Hiberi and the Georgians. In Georgia there is a metropolitan city called Thephelis, in which the preaching friars have a house. Beyond toward the east is the land of the Corasimini, but they have been destroyed by the Tartars. In these localities the Amazons used to dwell in ancient times, according to Pliny and the astronomer Ethicus. For the Amazons, as Ethicus states, were women leading a great army collected from women and without men. The Amazons, calling

men to them at certain times of the year, conceived; but they slew the male children when born, reserving the females, whose right breasts they cut off by the art of surgery in their youth, that they might not be hindered by their breasts in shooting arrows. From their youth they nourished at their own breasts minotaurs and centaurs, most savage monsters. Hence these creatures used to precede the Amazons as though the Amazons were their mothers, and the Amazons overwhelmed every army more by means of these monsters than by arms. Likewise from their youth they nourished elephants and trained them for battle; and thus for a hundred years they laid waste the southern parts of Asia and Greece, until they were carried off and destroyed by Hercules. These districts of the Georgians and of the Corasimini have the land of the sultan of Turkey and Cappadocia to the south. For on the southern side of the Pontic Sea is the land of the Sultan as far as Sinopolis, of which mention has been made. Next to it on the same side of the sea toward the west is the terra Vastachii, namely, Greece to the east. For it is called Greece to the west, where Constantinople is situated, and the regions joining it on this side of the Arm of Saint George in Europe.

Greater Armenia is beyond Cappadocia to the east, and therefore that Armenia, although south with respect to Georgia, yet lies to the east and extends as far as Media and Mesopotamia. This whole land is considered by many to be the land of Ararath, because in Isaiah it is stated that the children of Sennacherib, after their father had been slain, fled into Armenia. But Jerome in his second book commenting on Isaiah solves this problem with the statement that the region of Ararath is Armenia in the plain through which the Araxes flows, a land of incredible fertility up to the foot of Mount Taurus, which extends to this point. Wherefore Ararath is not the whole of Armenia, but a limited yet large region. For the Araxes River, from which the region is called Ararath, flows from its source for a distance equivalent to a journey of three months and more. Its source is a fountain in the mountains of Armenia, where near by rises the Euphrates on the north and the Tigris on the other side of the mountain toward the south. On the mountains of Armenia, as Scripture testifies, the ark of Noah rested; but it did not rest on the mountains of Armenia

without restriction, since the sources of those three great rivers are not in those mountains, but on the very lofty summit of Mount Taurus, where is situated the region of Ararath; as Jerome states, commenting on Isaiah. The ark in which Noah was saved, when the flood receded, rested not on the mountains of Armenia in general, but on the very lofty mountains of the Taurus, which tower above the plains of Ararath.

Near these mountains is a city that was very great before the Tartars destroyed it. For there were 800 churches of the Armenians in it; and in the time of Friar William, when he passed through it, there were only two small ones. Near there the blessed Bartholomew and the blessed Judas and Thaddeus suffered martyrdom. Two prophecies were uttered there. One is that of the blessed martyr, Methodius, who was of that race, and clearly prophesied of the Ishmaelites, a prophecy which had its fulfillment in the Saracens. Their other prophet is called Akaton, who prophesied concerning the Tartars and their destruction. For he says "from the north an archer race shall come, which shall subjugate all the nations of the East, and shall come into the kingdom of the West, namely, to Constantinople, and there shall they be destroyed by the princes of the West. Then shall all races be converted to the faith of Christ, and there shall be everywhere a peace so great, that the living shall say to the dead, Woe to you in that you did not live to the present time. A Christian Emperor shall place his throne in Taurinus in Persia." The Armenians consider that prophecy as gospel. This city just mentioned is now called Naxuam, which formerly was the capital of the kingdom, and is situated toward the northern parts of Armenia. For Friar William from the feast of Saint Clement journeyed up the Araxes, where it ends toward the north. On the Feast of the Nativity he came to that city, and in the octave of the Epiphany departed from it, and traveled along the Araxes to its source, at which he arrived on the second Sunday in Lent. Therefore it is further from that city to the confines of Armenia on the south than to the north.

Then further to the east are the mountains of the Alani and of the Aas, who are Christians, and welcome without distinction all Christians, both Latins and Greeks, whence they are not Greeks, and they fight with the Tartars; and so do the

Alani. After these to the east are the Saracens, called Lelgi who because of the strength of their country fight with the Tartars. After these to the east are the Caspian gates on the Caspian Sea, which Alexander the Great constructed where the mountains meet. For when he wished to conquer the northern race, he was unable owing to its ferocity and great numbers. And, as Ethicus says, he remained for a year and three months, that he might defend himself from them, and groaned because there was such a very wicked race in the regions of the north, and cried out to God praying that he would give relief lest the world be destroyed by them. Although he was not worthy to be heard, yet God of his goodness for the preservation of the human race commanded that there should be a great earthquake, and the mountains distant a stadium approached each other so that the width of only one gate separated them.

Alexander then built at the bottom of the pass bronze columns of wondrous size, and erected gates and covered them with bitumen, which could be dissolved neither by fire, water, nor iron. He sought this bitumen from the islands of the sea. These gates could be destroyed in no manner except by an earthquake; and now they have been destroyed. For Friar William passed through them with Tartars. Here is located the city called the Iron Gate of Alexander; at which toward the east begins Hyrcania beyond the Hyrcanian Sea, which is the Caspian, as was stated above. For Hyrcania lies on the southern shore of that sea and extends to the confines of India, on the southern side of which are Media and Parthia, as was noted above. These gates are not the Caucasian gates but the Caspian, as Pliny says, nor are the Caucasian gates the Caspian. For the Caucasian gates are distant from the Caspian 200 miles toward the Pontic Sea; and from the Pontic Sea they are distant 180 miles in the parts about Hiberia and Georgia. Those places with the intervening mountains are called the bars of Alexander, by which he restrained the northern nations from breaking through and laying waste the lands to the south. For Alexander waged many wars with them, as Ethicus states, and sometimes within three days there fell on both sides ten hundred thousand men. Alexander, however, conquered more by his art and genius than by force of arms. When they were aroused like bears from their caverns, he was not able to re-

strain them by violence, but God aided him by an earthquake and the closing together of the mountains. But now the gates have been broken, destroyed long ago either by an earthquake or by age.

We must give these places careful attention. For Gog and Magog, of whom Ezekiel prophesied and also the Apocalypse, have been shut up in these places, as Jerome states in the second book on Ezekiel. The Scythian race of Gog stretches across the Caucasus and the Maeotic and Caspian seas as far as India; and all who have been made subject are called Magog from prince Gog, and the Jews likewise, who Orosius and other sacred writers state will come forth. Alexander, as Ethicus states, shut up twenty-two kingdoms of the stock of Gog and Magog, destined to come forth in the days of Antichrist. These nations will first devastate the world and then will meet Antichrist, and will call him God of Gods, as also the blessed Jerome attests. Oh, how necessary it is for the Church of God that prelates and catholic men should consider these regions, not only for the conversion of the races there, and consolation of Christian captives in the same, but because of the persecution of Antichrist, so that we may know whence he is to come and when, by studying this matter and many others. At the Caspian gates the Caspian Sea begins to extend in length to the east, and in breadth to the north, and it is not smaller than the Pontic Sea, as Pliny states, and to make its circuit requires four months. Friar William on his return from the emperor of the Tartars traversed its western side, and on his journey to him walked along the northern side, as he himself related to the present lord king of France, in the year of our Lord 1253. To the north it has a vast desert, in which are the Tartars. Beyond these are many regions of the north before one arrives at the ocean. Therefore that sea cannot be a gulf of the ocean, which, however, almost all authors state it to be. But the experience in these times of Friar William and other believers shows that this Caspian and Hyrcanian Sea does not come from the sea, but is formed by the confluence of many large rivers. This whole land of the Tartars from the Tanais as far as the Ethilia belonged to the Cumani, who were called Canglae, and were all destroyed by the Tartars. That whole land was called Albania in ancient times. In this region

are dogs of such size that they kill lions and pull down bulls. Men hitch them to chariots and plows.

Then beyond the Ethilia is the third principality of the Tartars, by whom the indigenous people, the Cumani Canglae, were destroyed, as stated above. That principality extends from the river to the east a journey of four months on the south until one arrives at the principal country of the emperor. But on the north it extends for a journey of two months and ten days. From this it is evident that Cumania was a very great land. For from the Danube as far as this land, in which the emperor resides, the Cumani used to dwell, who were all destroyed by the Tartars except those who had fled to the kingdom of Hungary. This principality has on the north first greater Bulgaria, from which the Bulgarians came who are between Constantinople and Hungary and Sclavonia. For this Bulgaria in Europe is lesser Bulgaria, having the speech of those Bulgarians in greater Bulgaria, which is in Asia. These Bulgarians of greater Bulgaria are evil Saracens, a strange fact, since that land is distant from the iron gate or from the Caspian gates thirty days and more across a stretch of desert; and it is situated in the extreme north. Hence it is very strange that the religion of Mahomet has reached them so far removed from the Saracens. From this Bulgaria comes the Ethilia, of which mention has been made. Next to this land to the east is the country of Pascatyr, which is great Hungaria, from which the Huni came, who later were called Hungri and now are called Hungari, who uniting with them the Bulgarians and other northern nations broke, as Isidore states, the bars of Alexander. Tribute was paid to them as far as Egypt, and they destroyed all lands as far as France. Hence they have become more powerful than are the Tartars up to the present time. A great part of them live in the land now called Hungaria, beyond Bohemia and Austria, which is now among the Latins the kingdom of Hungaria. Near the land of Pascatyr are the Blachi from greater Blachia, from which came the Blachi in the land of Assani between Constantinople and Bulgaria and lesser Hungary. For that people is called now Ilac by the Tartars, which is the same as Blac. But the Tartars do not know how to sound the letter *b*. To the south of that desert of the Tartars

is the Caspian Sea, and then the Caucasian mountains to the east.

This principality extends from the Ethilia to Black Cathay, whence it is called Caracathaia. Cara is the same as black; and it is called Black Cathay to distinguish it from the other Cathay, which is far beyond this to the east many regions distant from this Black Cathay, of which mention will be made later. This land with those adjacent to it is the principal land of the emperor of the Tartars, in which he is always roaming with his court, traveling in summer to the cold regions, and in winter to the warm ones. This Black Cathay was the land of Prester John or King John whose fame used to be so great and regarding whom many false things have been said and written.

Here must be explained the origin of the Tartars, not only for greater evidence in distinguishing regions, but because of the race itself, which is now very famous, and has the world at its feet. We must note, then, that at the time of the war at Antioch, Coir Cham ruled in that land. For we read in the history of Antioch that the Turks sent for help against the Franks to King Coir Cham, who held the monarchy in the regions of the north at the time when Antioch was captured, and who was from Caracathaia. Coir is his own name and Cham his title, meaning diviner. For princes there rule the people by divinations and sciences instructing men in regard to the future or such as form the divisions of philosophy, as astronomy and experimental science, or the arts of magic, to which the whole East is devoted and with which it is imbued. All the rulers of the Tartars are called Cham, just as among us rulers are called emperors and kings. At the time of Coir's death, there was a certain Nestorian shepherd in that land, a man of power and master of a tribe called Naiman. These people are Nestorian Christians, who are wicked Christians yet say they are subject to the Roman Church. These Nestorians are not only in the land of Naiman, but are dispersed through all the regions to the east. The shepherd raised himself to the rank of king, and was called Presbyter and King John. This John had a brother, a powerful shepherd, named Unc, possessing pastures a journey of three weeks beyond his brother, and he was master of a certain village called Caracarum, which is now the imperial city, and larger than any other in the land of

the ruler, yet it is not so good a one as Saint Dionysius near Paris in France, as Friar William wrote to the lord king. Beyond the pastures of this man about twelve days' journey were the pastures of the Moal, who were poor people, foolish and simple, without law. Near these and similar to them were other poor people, called Tartars. At the death of John his brother Unc raised himself to the throne, and called himself Cham, whence he was called Unc Cham. He sent his herds toward the confines of the Moal.

Among these Moal was a certain smith, Cingis by name, who pillaged and carried off the cattle of Unc Cham himself. When the latter collected an army, Cingis fled to the Tartars, saying to them and to the land of Moal, "Because we are without a leader do our enemies oppress us." He was then made their leader, and collecting an army he attacked and conquered him. He became ruler in the land, calling himself Cingis Cham, and took the daughter of Unc and gave her to his son in marriage. She became the mother of Mangu Cham, who divided the kingdom among those Tartar chiefs who now rule and are at discord with one another. For to this Mangu Cham Friar William was sent. Cingis Cham himself everywhere sent the Tartars ahead in battle, whence came the fame of the Tartars, who have been almost annihilated by frequent wars. Although for this reason we call that race Tartars in whose hands are the chief power and dominion, yet are their rulers and princes always from the race of the Moal. They do not wish to be called Tartars but Moal; because their first emperor, namely, Cingis Cham, was of this nation. From this nation they have had up to the present, previous to those who now rule, only three kings, namely, Cingis Cham, Keu Cham, and Mangu Cham. Keu Cham was the son of Cingis, and Mangu was his son.

This race, then, of the Moal from its beginning has been a very foolish and poverty-stricken one, which, however, by divine permission little by little has subjugated all the neighboring nations, and in a short time has subverted the world in its whole breadth. If this race were a harmonious one, it would lay waste Egypt and Africa at the first assault, so that it would in this way surround the Latins on all sides. For at the present time on the north they rule as far as Poland, because all Russia

is subject to them; and all the land on the east as far as the Danube and beyond the Danube, namely, Bulgaria and Blachia, is tributary to them. Thus their empire extends to the land belonging to Constantinople. The sultan of Turkey, the king of Armenia, the prince of Antioch, and all princes in the east as far as India are subject to them with the exception of a few who are either too far distant or possess very strongly fortified places in the mountains which cannot be taken. First then in the land where the emperor dwells is Black Cathay. This was the land of Presbyter John. Next to it is the land of his brother, a journey of three weeks further, then still further the land of the Moal and Tartars, a journey of about twelve days. But this whole land is that in which the emperor dwells roaming through different places. The land, however, in which the Moal first dwelt, is called Oznam Kerule; and in that land the senate house of Cingis Cham still remains; but because Caracarum with its district was their first acquisition, they consider that city as the imperial one, and near it they choose their Cham, that is, their emperor. Then next to the Moal and Tartars to the east are brave men called the Tangut, who in the first place captured Cingis Cham in war; but peace being made, he again subjugated them. Their tribe has very spirited cattle with hairy tails like horses, the cows of which do not allow themselves to be milked unless they are sung to; and if these cattle see a man clad in red garments they spring upon him in their desire to kill him.

Next to these eastward are men called Thebeth, who were accustomed to eat their own parents as a filial duty, so that they might not make for them other sepulchres than their own vitals, of whom philosophers, as Pliny, Solinus, and others, write. Friar William also attests this fact in his book, and Friar Johannes de Plano Carpini likewise in the book he composed on the Tartars, among whom he was in the year of our Lord 1246, having been sent by our lord, the Pope, on an embassy to the emperor of the Tartars. But since they were from this practice an abomination to every other nation, they at length changed this rite. Yet they still make cups out of the bones of their parents' heads, from which they drink to their memory. Next to these to the east is a race of small people, swarthy like the Spaniards, called the Solangi, whose envoys

when they come to the senate of any ruler have in their hand an ivory tablet, on which they gaze when they state their mission as though all things were written thereon. Beyond these is a people, whose animals do not belong to any individual in particular nor have they a herdsman, but if any native wishes to have an animal, he stations himself on a hill and cries out as he pleases, and they come at his voice, and he takes what he wishes. But if a foreigner should come, he would put them all to flight by his odor and make them wild. Therefore when foreigners arrive, they shut them up in a house, and give them the necessities of life, until they receive a reply from those on whose behalf they come; nor do they permit them to go at large through the country.

Beyond these is Great Cathay, which is called Seres by the philosophers. It is in the extreme east, to the north with respect to India, divided from it by an arm of the sea and by mountains. Here excellent Seric garments are made in great quantities and are exported to other lands. This people breathes much through the nostrils. They are excellent workmen in every art, and there are good physicians among them in all matters except as regards the urine, about which they form no judgment, but make an excellent diagnosis by means of the pulse and by other symptoms, and are well acquainted with the virtues of herbs and the potency of the whole medical art. Many of them are among the Tartars. The common money of these people of Cathay is a card of mulberry bark on which are stamped certain lines. Nor is this strange, since the Ruscani who are near us have as money the face of squirrels. This Cathay is not twenty days' distant from the land in which the emperor lives. In that land are lofty cliffs on which certain creatures dwell with a human form in every respect; they do not, however, bend their knees, but walk by leaping. They are not over a cubit in height, have the whole body covered with hair, and do not speak. Hunters bring beer and make holes in the rocks like cups, and those animals come and drink the beer, fall asleep, and so are captured. The hunters bind their hands and feet, and opening a vein in their necks draw three or four drops of blood, and then untie them and let them go. This blood is most valuable as a purple.

We must note that from the beginning of Cathay as far as

the eastward limit they are for the most part idolaters, but intermingled with them are Saracens and Tartars, and Nestorians who are imperfect Christians, with their patriarch in the East, who visits the districts and ordains infants in their cradles to holy orders, because he alone ordains, and cannot visit a place more than once in about fifty years. He says he has authority from the Roman Church dating from the remote past and is ready to obey this Church if the way were open. They teach the sons of the noble Tartars the Gospel and the faith and others also when they have the opportunity; but because of their scanty knowledge and their evil morals they are despised by the Tartars. In the Mass they consecrate a piece of bread as wide as the palm, and they divide it first into twelve parts corresponding to the number of the Apostles and then they divide those parts according to the number of the people. The priest places in the hand of each the Body of Christ, and then each one takes the Element from his own palm reverently. But idolaters are most numerous in all these regions, and all agree in having temples as we do and large bells. Therefore the Churches of the Greeks, of Armenia, and of the whole Orient are unwilling to have bells on account of the idolaters. The Rusceni, however, have them, also the Greeks in Cassaria. All their priests shave the whole head and beard, and observe chastity from the time of shaving the head, and they live a hundred or two hundred in a society. On the days when they enter their temples they place in position two benches, and sit in a straight line, choir facing choir on the ground, with books in their hands which sometimes they lay on those benches. They keep their heads uncovered as long as they are in the temple, and they read in silence, nor would they in any manner speak in the temple except the words of their office. Wherever they go they have in their hand a string of one or two hundred nuts, like our Pater Noster, and they continually repeat these words, "On man baccan," that is, God thou knowest. These things are common to all idolaters. But the Ingeres who dwell in the land where the emperor lives differ from the others. For the others do not maintain that there is only one God but that there are many, and they adore the creature. But the Ingeres, owing to the proximity of Christians and Saracens, hold that there is but one God. They are excellent writers,

whence the Tartars have adopted their letters, and they are the great writers of the Tartars. They write from above downwards, and increase the lines from left to right and read. The Thebeth write as we do, and have characters similar to ours. The Tangut write from right to left, like the Arabs, but increase the lines ascendingly. The people in Cathay to the east write with the same instrument with which painters paint, forming in one character groups of letters, each group representing a sentence. By this method characters are formed with many letters together, whence reasonable and natural characters have been composed of letters, and have the meaning of sentences.

The whole land from the Danube to the east is called by the ancients Scythia, whence the Scythians and all the regions of the Tartars belong to Scythia as well as Russia and all as far as Germany.

I have described, then, all the regions of Asia and Africa and the northern ones of Europe. I shall now note briefly the eastern, southern, and western ones of Europe. For nearly all of them are known to all men. It has been stated that western Albania terminates at the Danube on the Pontic Sea, and extends to lesser Hungary. But on the other side of the Danube on the same sea the first country met was called Thrace in ancient times, in which Constantinople is situated. Beyond the Danube to the west it joined Moesia, but in those regions are at present Blachia and lesser Bulgaria. Then comes Hungary to the west, then Moravia, which is next to the kingdom of Bohemia. To the south of this is Histria; in the west Bohemia succeeds Moravia, and Austria, Histria. Then comes all Germany to the west, and then France, countries which are known.

After Thrace toward the south is Macedonia, famous because of its very great kings, Antigonus, Philip, Alexander the Great, which was called by another name, Emathia. Next to it to the south is Magnesia; then Thessalonia, to the people of which the Apostle wrote. Then still to the south is Boeotia, where the famous city of Thebes is situated, eighteen miles to the east of which is a well-known city named Niger Pons. Next to those lands to the west first is Sclavonia on the borders of Macedonia, Thessalonia and Bulgaria. Next to Boeotia is Attica, called from the city of Athens, nurse of philosophers,

where Socrates, Plato, Aristotle, and other famous men taught. This Attica is part of Arcadia, according to the philosopher Ethicus, which is a very famous province not only on account of Athens, which Ethicus calls the navel of Greece, but because of its military power. For this land was called Sicyonia from King Sicyon, whence it is called the kingdom of the Sicyonians, one of the four principal kingdoms of the world which have been from the beginning, namely, the kingdom of the Scythians, originating under Reu, father of the great-great grandfather of Abraham; the kingdom under Seruch, great-grandfather of Abraham; the kingdom of the Assyrians; and that of the Sicyonians under Nachor, grandfather of Abraham; as Bede writes in his Chronologies. This last is the kingdom of the Greeks. For, as Ethicus says, all Greece has combined under the name of Sicyonia, since the kingdom of the Greeks was called the kingdom of the Sicyonians because the chief military strength was among the Sicyonians, who are Arcadians. I have treated these matters more fully, because all the histories have a great deal to say about the kingdom of the Sicyonians. In the philosopher Ethicus alone can be found clearly stated the explanation of the word and of the signification of the name. According to Pliny there is Achaia, then the province of the Peloponnesus, in which is famous Corinth. Then comes Locris and then Epirus, and so Greece ends.

Next to Greece westward is Dalmatia, in which is Duracium. Next to it is Illyria, from which the Illyrian Sea is named, which extends from the river Arsia to the river Dirinus, called as a whole by another name, Liburnia. But the Illyrians belong properly around the river Dirinus, and this country extends in length from the Arsia to the river Dirinus, and lies beyond the Adriatic Sea, which is the sea of Venice. At its western end is Venice. Illyria has many small islands, and has a length of 530 miles, a width of 315 miles. I have quoted these statements word for word from Pliny, because we of modern times do not know how to understand the word of the Apostle when he says he thoroughly disseminated the Gospel as far as Illyricum. In many of the histories we find Illyricum and the Illyrians and we do not understand the statements made. Whence the Illyrians lie between Dalmatia and Histria. Therefore, where now are located Sclavonia and Forum Julii and the districts

of Venice, the Illyrians used to dwell. All these nations are included between the Arm of Saint George and the great sea on the east; and between the Danube, which is called the Hister for much of its length to the north; and between the Adriatic on the south. Distances in miles and days' journeys can be given in some of them. For it is more than 400 miles along the seacoast from Venice to Duracium. From there the distance to the famous city of Patras is forty miles, thence to Corinth sixty miles, thence to Athens forty miles, thence to Thebes forty, thence to Niger Pons eighteen, from which the distance by sea to Constantinople is 500 miles. From Niger Pons to the island of Crete is 300 miles. Then on the other side of the Adriatic Sea between it and the sea which runs from the Adriatic to Spain, lies all Italy, then Provence, and finally Spain. Since these countries are well known, nothing more need be said about them. This then, is the history which I have wished here to compose in accordance with the experience of writers on nature and of travelers respecting the places and races of the habitable world, until your Reverence requires the principal work.

After the description of places four other topics should follow, namely, a certification of the natures of the fixed stars and of the planets, that by these means a surer certification may be made of all the characteristics of the places and things located, to the end that a judgment may be made respecting the present, past, and future, so that at length, in the fifth place, actions may take place promoting all things advantageous to the state and excluding all things harmful. But since I have not been able owing to hindrances to complete the description of places in a form in accordance with the methods of writers on nature, and these four topics follow, it has been necessary to abandon the treatise on them; I wish, however, here in a summary to explain the design of the treatise on these four topics, as though the treatise had been written, just as I have done concerning other topics which I have handled; to the end that your Wisdom may see what is needed to secure advantage for the state, and how you are to seek writings and wise assistance from each man.

It was stated above that there are 1022 fixed stars, the size of which can be learned by astronomical instruments. These

stars possess different forces in heat, cold, moisture, dryness, and all other qualities and natural changes. Among these stars are the principal ones of the twelve signs, by which all other things are especially subject to change. The signs are Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricornus, Aquarius, Pisces, which are so named because the stars in the heavens have the quality of the things thus named. These signs Aries, Leo, and Sagittarius are in effect fiery; Taurus, Virgo, and Capricornus have reference to earth; Gemini, Libra, and Aquarius have reference to the air; Cancer, Scorpio, and Pisces are aquatic signs. Aries, Cancer, Libra, and Capricornus are changeable signs, because in them are renewed the four principal complexions of all things, namely, warm and humid in Aries; warm and dry in Cancer; cold and dry in Libra; cold and humid in Capricornus. Taurus and its followers are fixed signs, because the qualities named are fixed in them and are completed. Gemini and its followers are called common signs, because the quality in them turns to a new one which is renewed in the sign following. Moreover, these signs have many other differences and properties which must be determined by other treatises.

The first difference of planets is in their proper forces. For Saturn is cold and dry and the cause of all sloth and death and destruction of things through the egress of dryness and cold. Mars is destructive because of the egress of heat and dryness. These two planets never do good except by accident; just as a poison sometimes is an accidental good, like scammony, which clears away the matter of disease, but yet of itself injures nature. These planets are called unfair, and unfortunate, and malevolent. Jupiter and Venus have heat and humidity; but Jupiter more so and better; and these planets are called fair in fortune and benevolent. Mercury is in a middle state between good and bad and is of a changeable nature. For with the good he is good and with the evil he is evil. The moon is cold and humid. The sun has generative and vital heat, because he is the cause of life and of generation in all things, whence although he is hot and dry, yet his heat does not cause corruption, but is generative, and his dryness is not death-dealing, and for this reason different from that in Mars.

The planets, moreover, possess other virtues from the signs;

for when they are in a warm sign they have the power of producing heat, and so, too, with respect to the other signs. But besides these virtues the planets have special ones, of which mention was made above, which are house, exaltation, triplicity, boundary, and face; and in accordance with these dignities they have wonderful effects. And again there are forces with respect to their aspects, which are conjunction, opposition, etc. Planets are said to be in conjunction when they are in the same sign, in opposition when one is in the seventh sign from another. There is a third aspect when they are four signs apart; a fourth when they are three signs apart; and a sixth when they are two signs apart. Opposition and the fourth aspect are evil of their own nature. The third aspect and the sixth are good, and conjunction likewise. These aspects, moreover, are considered in the five planets, especially with respect to the moon and sun. When, therefore, an evil planet is in a bad aspect, the condition is detestable, because it then doubles the evil; but when a good planet is in a bad aspect, the condition is tolerable; and if an evil planet is in a good aspect, its evil is mitigated. But when an evil planet is in opposition or conjunction with an evil one, then is the evil a great one.

Planets have also a great variety of actions as regards their eccentrics and epicycles. For when they are in the upper portions of their orbits, they cause very vigorous actions, but in the lower positions weak ones: since when they are in the upper portions of their circles, which positions are called auges, they move around the world in a daily motion in great circles, and then they move rapidly, and speed of motion induces vigorous action in things which have been created to move, of which kind are the stars. For they have various effects with respect to the parts of their revolutions and their whole revolutions. For in accordance with their transit through a fourth of the heavens, the half, three quarters, and the whole circle, they have sensible differences in their effects. And not only so, but this is also true with respect to any one of their revolutions within fixed limits; as, for example, Saturn, when he has completed ten of his revolutions, causes a great change in the world, as we showed above in the matter of the sects. The twelve houses also, into which the whole heaven is divided, and which were discussed above, are especially studied with re-

spect to the forces of the planets. For the planets draw various potencies from these houses, and by means of the forces of these houses the planets effect different results in this world: and therefore mathematicians teach us to give very great attention to these houses. These, then, are the basic principles in the actions of the stars, the roots, as it were, which have branches and flowers, and fruits without number. This, then, is the design of the treatise, I proposed to compose in this work on the virtues and actions of the stars.

In the third place, we must consider how the places in the world and the things are altered in their characteristics by the principles just stated. Certain general discussions have been presented on this matter in what precedes, as was necessary, but in this part of the work more things should be attested in particular. It is a fact, according to Aristotle, that the heavens are not only the universal, but the particular cause of all terrestrial things. For Aristotle says in the second book on Generation that the elements act more weakly with respect to the heavens than tools with respect to the workman, as, for example, a hatchet and pickaxe with respect to a carpenter; and therefore although all things are done here below through the qualities of the elements, yet their relation to the heavens will not differ from that of tools to the workman. Therefore if the workman is the active principle universal and particular with respect to the work, much more the heavens with respect to generating a thing. Averroës says in the seventh book of the Metaphysics that the force of the heaven has the same action on putrefied matter, as the force of a father in the semen. Therefore the things generated by putrefaction, although they are animate, are made directly from the heavens, and much more vigorously so other inanimate things. This holds true not only in these things, but in things generated by propagation in plants: because Aristotle says in this book on Vegetation that the sun is the father of plants and the moon their mother; and in the case of men and of animals he says that man begets man with the help of the sun. But Averroës says that the sun does more than man in producing a thing. For the force of the sun continues in the seed from the beginning of generation to the end, while that of a father does not, but is confined to one act only, namely, sowing of the seed; and therefore it

would accomplish nothing, unless the force of the sun were continuously multiplied and infused, regulating the whole generation.

The complexions of all things are due to the heavens, and not only are regions diversified by the heavens, but things in the same region and parts of the same thing. This holds true not only in regular, but in monstrous generation and in the faults and errors of nature. For owing to differences of horizons, as the separate points on the earth's surface are centers in new horizons, it is manifest that all things vary, as we noted above with regard to plants of different species, and with regard to the difference in twins in the same womb: because the vertices of different pyramids containing the forces of the stars and of the parts of the heavens above the heads of the inhabitants come to the individual points of the earth, so that complete diversity takes place in things. But another difference is due to the distance from the poles and from the middle of the world. The cause of this is twofold. One is the universal cause, namely, the distance of the sun or its nearness as we stated above in the section on the places of the world. The second is the particular cause, namely, the diversity of the fixed stars above the heads of the inhabitants. For in particular by means of these stars do natural things vary in different regions, and men also, not only in their natural qualities, but in their morals, sciences, arts, languages, and in all other things. The third cause arises from the predominant force of the twelve signs. For the different signs are dominant in different regions, either because at the beginning of the world they were in the direction of those creatures when they received their first forces, and what the jar receives when new it retains the savor of when old; or because they are similar in nature to the stars which revolve over the heads of the inhabitants. The fourth cause is due to the planets. For the planets are assigned to the different regions owing to their domination, as in the case of the signs, and this follows from the twofold cause stated. Now regarding the signs, in what regions they are to be assigned and likewise the planets, it is difficult to attest, for authorities differ. A treatise must unfold these matters.

But there is no full attestation regarding these as well as many other difficulties except from the books of the Hebrews,

which they composed as the first astronomers who had a special revelation from God in all matters. Not only is there a diversity in quality in the different regions due to the stars, but also in the things of the same region. For certain things are affected by the particular quality of the sun and certain by that of the moon, and this is true also regarding the other planets. According to the five dignities previously mentioned of their planets do things become vigorous, greatly strengthened, and augmented. When, however, the planets are in positions opposite to their dignities, things deteriorate and suffer loss of their natural vigor. The same is true of the signs, for different things follow the characteristics of the different signs. For in accordance with the fact that certain signs are fiery and certain planets also, that is, hot and dry, some things are of a fiery nature, and things of this kind are called martial from the planet, and are of the nature of Aries, Leo, and Sagittarius, which are hot and dry signs. The same principle holds true with regard to other characteristics of things, of signs, and of planets. To name, however, and mark things individually with respect to planets and signs, is a matter quite difficult of attestation and impossible except through the books of the Hebrews, that we may have recourse to the fountain of certainty. The difficulties just stated regarding the assignment of the signs and planets to the things of different regions and of the same region are among the greatest of philosophy. In this matter there is great diversity in Latin authors.

Not only do things of the same region vary thus, but parts of the same thing and especially so in man, since all things are on man's account. For the head is of the quality of Aries; the neck of the quality of Taurus; the shoulders and arms of the quality of Gemini, and so on. Regarding this division authorities are in practical agreement, and an adequate reason dictates it as well as experience, which is more important. For if the moon is in Gemini, the sign corresponding to the arms and shoulders, it is dangerous to touch such members with iron, as in blood letting, scarifying, or cupping and especially with knife or sword. And not only so, but this holds true of all surgical remedies; for they cause great difficulty and languor, and sometimes death; which they would not do, if the moon were in another sign. For Ptolemy says in the Centilogium, "If the

moon is in a sign corresponding to a member, there is danger in touching the member with iron." Hali the physician in this matter states that due to the presence of the moon in such a sign humors flow together to the corresponding member and cause trouble. Experience proves this daily. For in the year preceding, a somewhat famous physician in France had a surgeon treat the tibia of his brother. But a skillful astronomer forbade his doing so, because the moon was in Aquarius, which is the sign corresponding to the tibia. And it happened that his infirmity and languor continually increased until death. Cases of this kind happen often, but are not understood, owing to ignorance of astronomy.

But the things of the same region not only thus vary in their complexions through the diversity of the signs and planets at the same time, but at different times. For a planet is dominant over every hour in particular, and half of a sign rises above the horizon every hour, from which the hours always vary, and the quarters of days likewise, and the days themselves, since as in every tongue the days are named from the planets, so have they diversity from them, as all learned men agree. This is by divine ordinance from the beginning of the world. Whence during the first hour of the Sabbath day Saturn is dominant and continues chiefly so over the entire day, because by his quality is the first hour affected, which is the chief one and the beginning when the force of Saturn is derived for the whole day. Then Jupiter is assigned to the second hour, Mars to the third, the sun to the fourth, Venus to the fifth, Mercury to the sixth, the moon to the seventh, and again Saturn to the eighth, and so on, so that he is dominant in the fifteenth, and in the twenty-second; Jupiter in the twenty-third and Mars in the twenty-fourth, and thus is completed the natural day of the Sabbath, so that the sun begins to be dominant in the first hour of Sunday, which is therefore called the day of the sun among all nations. On this theory proceeds the variation in all the days of the week and in the hours. From these facts the characteristics of the quarters of the day and of the night are obvious; so also we note which are the hours of blood, which of jaundice, which of phlegm, and which of melancholia. But physicians ignorant of astronomy do not judge respecting the quality of the hours except by the in-

crease or diminution of the heat of the sun or by its absence. For they merely consider that six hours of the natural day are hot and moist, and the remaining six are hot and dry; still another six are cold and dry, and the last six cold and moist. But they do not consider of what quality the sign is that rises every two hours, and which planet dominates at the hour according to the rule given above; moreover, which planets rise above the horizon, although these matters and certain others should of necessity be considered. Yet this diversity in days and hours should be well known to every man, and especially to physicians, and to every one who wishes to preserve his health. For according to the diversity of the complexion of each one and according to the diversity of age and occupation, should each choose different hours for blood lettings, for medicines, and for all other actions of life, and for business affairs and occupations and for undertaking tasks, or he should be guided by the knowledge of others, because the forces of the heavens in these hours and days in various ways influence the different complexions of the healthy and the infirm. And further, as the complexions vary, the minds are aroused and influenced to desire gratuitously to follow the motion of the complexion, even in all voluntary actions, the liberty of the will, however, in all cases being preserved. Whence on the Sabbath day and especially during the first hour, a man ought not to be bled, nor should anything else of importance be begun which has reference to the complexion, either first in matters pertaining to nature or second in matters of the will. Such caution must be observed owing to the bad quality of Saturn, who in all matters causes misfortune as far as he is concerned, unless something else prevents. Yet all men, due to error, have themselves bled on Saturday, which they do owing to the enjoyment of rest on Sunday from their occupations and labors.

Not only in hours and days does a great variation occur to be considered as due to the heavenly bodies, but also in the week. This is due particularly to the age of the moon. For while the moon is crescent, all things increase; while it is waning, all things decrease or suffer diminution. This fact is considered not only by astronomers, but by physicians; as, for example, Galen in his book De Dynamidiis, and others in the light of former experience, as in the case of the seas, the brains of

human beings, in marrow, and in shellfish and in all other things. For they are augmented and are full when the moon is full and diminish with its waning. For the moonstone called selenite increases and decreases according to the moon, by means of which the sacred writers in ancient times proved the changes in lunation of the paschal feast, as was stated in its proper place in this work. For a certain kind of mallows grows up at the new moon, and increases until full moon, and then decreases with the moon. It is a plant of wonderful virtue; with the new moon two leaves sprout forth on both sides of the stock and in the second quarter two others, and so on until full moon, and then in a similar way they fall as the moon wanes. But as Ptolemy says, and Hali explains in the fifty-sixth proposition of the Centilogium, the humors in our bodies in the first and third weeks of the moon recede from the interior parts to the external ones, just as rivers flow from their channels. But in the second and fourth weeks they flow back from the external parts to the interior, and in this there is a great and wonderful change in things. Hence it follows, as a matter of fact, that in the first week and in the third we should employ external evacuations, like blood letting, and in the second and fourth weeks laxative medicines; because Hippocrates in the first article of the Aphorisms says that we should draw from the direction found in nature through the proper region, that is, through the part of the body to which the natural humors flow. But physicians ignorant of astronomy pay no attention to this fact, frequently to the injury of their patients.

Another great change in things is brought about by the lunar mansions, which number twenty-eight. A mansion is the space of the Zodiac which the moon traverses in a day. Moreover, these mansions are distinguished, because certain are temperate, certain are distempered in dryness, cold, heat, or moisture. Accordingly on any day if one sees in the morning in which mansion the moon is, he will be able to judge in regard to rain and atmospheric changes, as Albumazar shows in his larger Introduction, and as is obvious by experience. We must consider especially the disposition of the moon at new moon; for of such a disposition must be at least the first week or fortnight, and at different times the whole month; similarly at the beginning of the second week, of the third, and

of the fourth the same observation holds. For at those quadratures the action of the moon is strongest, according to Galen in his book on Crisis and Critical Days, as the moon crosses the quarters of its circle. Not only weeks, but whole months vary especially owing to the motion of the sun in the different signs, according to its recession from us or approach to us. Thus the quarters of the year change obviously in their complexions, since from these commonly the four principal complexions have their origin, namely, heat and moistness in spring, heat and dryness in summer, cold and dryness in autumn, cold and moistness in winter. For the mutation of the stars is strongest at the quadratures of their circles, as authors show and experience attests.

There is a greater mutation of years through these other planets, which according to their revolutions at the quadratures of their circles and at the revolution of the whole circle change years; and especially the three superior ones, Saturn, Jupiter, and Mars; as in the case of very great matters, which come slowly, because these planets are slow in their motion, and therefore their effects are not daily or monthly, as are those of the moon or sun. Moreover, effects of this kind are floods, earthquakes, pestilence, severe famine, appearance of comets and of other fires in the air; as Albumazar teaches in his book on Conjunctions, and as all scientists agree. Hence when a dreadful comet appeared in the year of our Lord 1264 in the month of July, the fact is established that it was generated by the force of Mars. For although Mars was then in Taurus and the comet began in Cancer, it did not cease speeding to its cause, namely, Mars; just as iron hastens to the magnet. For just as a magnet attracts iron so the planet, by the force of which the fiery vapor is raised and assimilated to the celestial nature, attracts the comet, and therefore since it moved toward Mars and there disappeared, of necessity it was caused by Mars. Then since the nature of Mars is fiery, whose nature is to increase jaundice, and consequently to excite men to anger, discord, and wars, therefore it happens that that comet portended angry passions, human discord, and wars, as learned astronomers teach us. But the experience of the whole Church too truly has attested the fact through the wars of England, Spain, Italy, and other countries, which happened about that

time and have happened from that time. Oh, how great an advantage might have been secured to the Church of God, if the characteristics of the heavens in those times had been discerned beforehand by scientists, and understood by prelates and princes, and transferred to a zeal for peace. For so great a slaughter of Christians would not have occurred nor would so many souls have been sent below.

Not only do I make this statement on account of the revolutions of planets generating comets and the like, but more so because of the conjunctions of the superior planets from the time mentioned. Conjunctions, moreover, of the planets increased greatly in these times; but in the chapter above on the sects and on confirming the faith of Christ the remarkable knowledge of astronomers regarding these conjunctions was cited, showing how the usual laws of nature are changed, and the minds of men are aroused to seditions and to changes in customs and laws, to discords and wars, and how dominions and kingdoms are changed, and the vicissitudes of princes renewed. Albumazar and other learned men clearly teach this. If these examples should prove to be on too high a plain, let us turn our pen to common examples and to such as are useful for men's bodies. For Ptolemy says in the nineteenth proposition of the Centilogium, "If any one take a purgative when the moon is in conjunction with Jupiter, its action will be shortened and its effect lessened." Hali states that the reason of this is found in the fact that nature is so strengthened from the beneficial action of Jupiter that it hinders the effect of the medicine. If the moon should be in conjunction with Saturn, the one taking the potion will suffer gripings and be in danger owing to the evil influence of Saturn, nor will he be able to relieve himself, owing to the dryness of Saturn, by which the medicine will be retained in his body, because a dry substance is easily retained.

But how diseases are to be learned in conjunctions of this kind and in the other aspects and dignities of planets, medical authorities show excellently; and especially so Hippocrates in his book on the changes in human bodies which happen from the motion of the moon when subject to the conjunctions and other aspects of the planets. Galen, moreover, states in the third book on Crisis and Critical Days, "I have

returned to a matter which I have studied with zeal and careful investigation, and I have found the same to be true and certain which is imperishable, a fact which the Egyptian astrologers discovered, I mean that the moon marks on days what the condition of a man will be in his sickness and in his health; that is, if certain equal stars are connected with the moon, and these are stars called fortunate ones, those days will be beneficial to him. And if certain stars departing from equality are connected with it, those days will be days of injury and sadness." He here uses the term "connected with" as referring to conjunctions and other aspects, and he has here much to say on this subject.

Hali the physician, also, in his book The Royal Regimen shows clearly that physicians need study of this kind, and hence he says, astronomy is needed by medicine, which uses selected remedies at selected times, when the moon is tempered by good and fortunate planets and by favorable signs of the Zodiac. All authors agree in these matters. Because of these conjunctions and reciprocal revolutions of the planets, according to Avicenna in his second book on Animals, all generation is augmented and regulated, also the beginning of life and of death. Whence he says it is necessary that the limits of life and of death should have been placed in a species, as long as life is concordant with the revolution of some star or of many stars. The first limit is the day with its night: then the second is that established by the moon at the quarter of its circle; then there is the month, which is the circle completed at the conjunction of the sun and moon; then the year of the planets; then the year of mean conjunctions and reversions to those forms in which these conjunctions took place, which tend to the augmenting of natural things and the diminution of unnatural things. Not only do these things happen in regular generation, but in that which is monstrous and in the faults of nature, as Avicenna himself teaches in the same book, saying, "If the embryo is able to receive humanity, it is able to receive animality, as in things monstrous, for example when the son of a man has the head of a ram, and a lamb the head of a bull, since the force in it has induced forms and celestial figures, things happening to anybody."

Not only in these ways do changes occur in the conditions of

terrestrial things, but they are also due to the mounting of planets to the apsides of their orbits, and then to their descent to the opposite point, since their motion is rapid at their apsides and slow at the points opposite, as we see by experience. For all things produced on the earth grow more about the summer solstice, when the sun is at its apsis, and gain more vigor in one day than at other times in a week. And when the moon is at the apsides of her circles, as at new moon and at full moon, her actions are more vigorous, as is obvious in the tides of the sea and in fishes; for then are fishes better, then are shellfish more healthy, as authors teach and experience shows. This same is true of all the planets.

But the last point I wish to touch upon is regarding the twelve houses, which arise from the division of the heavens into twelve parts, the study of which is especially recommended by the philosophers. For Albumazar in his book on Flowers says that these houses must most certainly be discussed and examined. For by means of these houses we first consider which planet controls the complexion of the whole year. This study is made at the beginning of spring, when the sun enters the first minute of Aries at the vernal equinox. By these attestations we know how the planets affect the complexions of individual days and hours and all things, as they rise above the horizon. For astronomers show this fact clearly and experience manifests it. These then are the basic principles—roots, as it were,—regarding change in the complexions of things due to the forces of the stars. In a treatise on this subject the branches and fruits and flowers must be displayed along with tables and excellent drawings, whence the potency of figures and computations is more obvious; moreover, the utility and beauty of this knowledge are very great.

After these matters a fourth follows, namely, consideration regarding judgment and knowledge of the past, present, and future. For if the cause of the complexions of things is the celestial constellation, an effect of this kind can be known through this cause. The method or time is attested by the sacred writers, and especially by the patriarchs from the beginning of the world, from whom the philosophers learned the possibility of forming judgments. We must consider that all philosophers have agreed on this point, and Aristotle has attested

it in his book on this subject, and experience teaches it. Nor is there any contradiction except on the part of boundless ignorance, which is rife in the common throng and in those rulers who reprobate and neglect all things of which they are ignorant. The method of forming a general judgment by means of the planets consists in this, that a man know by the tables and instruments how to equalize the motions of the heavens and find the positions of the planets; and how to judge which of them has the more numerous and stronger influences from its position in accordance with those five famous ones, namely, house, exaltation, triplicity, boundary, and face; and along with this how to view the influences which happen from the aspects of those planets and from their motions at the apsides of their orbits and from the twelve houses.

When he has carefully examined and considered these matters and those connected with them, then if the sun shall be found to have more evidences and influences of this kind, he must decide according to the solar complexion in things, because it is dominant in them; and he must proceed in this way with respect to the other planets. But a particular and special consideration in individual matters has its own fixed rules according to the condition of affairs. One can examine history at past periods, and study the effects of the heavens from the beginning of the world, as in the case of floods, earthquakes, pestilences, famines, comets, prodigies, and other things without number, which have happened both in human affairs and in nature. After he has discovered these facts, he should consult the tables and canons of astronomy, and he will find that there are constellations corresponding in an appropriate way to the effects in each case. He should then study with the help of tables similar constellations in future time, either near or remote according to his wish; and he will then be able to express judgments on the effects, because they will be similar to those in the past, since if we assume a cause the effect is taken for granted.

Instruction of an introductory character regarding these judgments is given in sufficient fullness in the work of Albumazar dealing with this subject, and in the book of Alkabiz and in that of Hali Abenragel. But the roots, as it were, of forming such judgments are given in the hundred words of Ptolemy,

who has more weight in speculative philosophy. The branches are developed in the fourfold divisions of Ptolemy, as those same authors state. The flowers and fruits are collected in many books, but particularly in the book of Conjunctions by Albumazar, through which a knowledge of this science has come into the hands of the Latins. I make this statement, because they do not yet possess complete knowledge on these matters, since the Latins have nothing of value except from other tongues; and the translators have been few and bad, as is obvious. For the books of the Hebrews give definite information on these topics, a certification which Aristotle studied and reproduced in Greek. For Averroës says in the fourth book of the Heavens and the World that Aristotle attested this matter in his book on celestial impressions, a book which is superior to all the philosophy of the Latins and which can be translated by your order.

The fifth consideration stated above is the principal one of them all, for all those named lead up to it; since it does not suffice a state to know all things, but useful measures must be known and taken in advance, and harmful things avoided. But in this matter, although geometry, arithmetic, and music give a great deal of assistance, yet astronomy regulates all things, because every splendid work ought to be done at times selected. Therefore the activities of other sciences require proper times, the selection of which is based on the knowledge of the astronomer, and for this reason astronomy is mistress of all other sciences in this particular, although it has special remedies also without number, in which other sciences possess no potency. Because the potency of this science is so general, Aristotle, the wisest of philosophers, teaches Alexander in the book of Secrets that he should neither eat nor drink, nor do anything without the advice of an astronomer, because there are times selected for all things; for all things have a time, as Solomon, a wiser man than Aristotle, states. Aristotle raises an objection to his own statement, saying, "God has seen beforehand all things from eternity, therefore the astronomer cannot hinder or change these things." He replies that those things which God saw beforehand are immutable. But the effects of those things which God has placed in the power of man in accordance with his eternal foresight, man can change as he wills, because

in contingent things there is a choice. God has not imposed necessity on human actions, although he has known from eternity how a contingent matter must terminate, and there is freedom of the human will. Therefore man can take thought beforehand for all his advantages, and remove obstacles, if he is skillful in this science. He gives an example. For if, as he says, there must of necessity be excessive cold at a future time, the astronomer foreseeing it can arrange for relief, so that the cold can be borne without injury, which others without warning have been unable to endure. For the astronomer can prepare in advance warm places, warm foods, warm clothing, and many other remedies, so that the cold will harm him in no way, although others who have not foreseen it are dying from the cold. It is therefore in the power of a man skillful in this science to avoid what is harmful and to secure what is useful.

Isaac in his book on Fevers, in the chapter on pestilence, teaches this truth excellently, not only in the matter of diseases, but in all things in general, saying that the rational soul is worthier than the stars, for their action does it very little harm unless it is possessed with ignorance. For provided he himself knows their action, he will be able wholly to be on his guard; and he says, "This fact is attested by what we see done by very excellent mathematicians, who since they know with the greatest certainty the days of death in the case of those who are putting to sea, are able effectively to guard them; similarly in the case of those who are to die in war." He adds, moreover, "Man differs from the animals, for it is the function of reason and discretion to inquire and long for what is good and to reject what is evil unless a man is possessed with ignorance." Therefore Ptolemy says in the fifth book of the Centilogium, "An excellent astrologer will be able much more to prevent what is destined to come according to the stars"; and in the eighth book he says, "A wise soul will aid the work of the stars, as a sower does the forces of nature," whence it will be able to drive away what is harmful and promote what is useful. Isaac, moreover, gives an example regarding a coming pestilence, and proposes a question to himself on the ignorance of physicians, just as Aristotle did. He asks them whether a rotting of this kind must come owing to the heavens, since in that case the physician cannot prevent, and therefore

foreknowledge of this event seems useless. But he answers the question, saying that corruption of the air harms only bodies ready for it; and therefore when the physician has seen the sign of a corrupted air at any future time of the year, he will be able to cleanse nature, and carry off the evil disposition of the body, so that he knows how to resist the coming corruption. For if he sees by the motion of the stars that heat is being generated in the air and too much dryness and burning, he should hasten to purge away the jaundice of those in whom there is a choleric habit, and he should give cold and moist foods and drinks which resist the coming heat. Hali expresses a like opinion in expounding the fifth proposition of the Centilogium. From these facts it is evident that the astronomer is able to offer remedies against things harmful and to promote things useful, not only in diseases but in other matters generally, by the correct method of selecting the time suitable for all actions, and by the removal of things harmful. This truth holds good especially in the case of our human bodies, than which nothing is more important as far as the particular good of our citizens is concerned.

But nevertheless, as regards the common good of the state and of kingdoms, more works are wrought through the potency of astronomy than any one can tell, and more than any one can explain in writing; for these are many of the most secret works of science. But owing to the importance of the matters and the ignorance of the majority of students, who care nothing about the works of science, and owing to the frauds and evil practices of many who have abused these matters, they are always kept secret from the commons and from their rulers. Concerning these matters, however, Moses and Aaron, Solomon, Aristotle, Ptolemy, and other scientific men have labored very admirably. Hence since this subject is one of the most important ones and in a measure potent in all matters, it is not proper that it should be kept hidden from your Glory. Since you have commanded me to write on the wisdom of philosophy, I shall cite to your Clemency the opinions of sages, especially since this knowledge is absolutely necessary to the Church of God against the fury of Antichrist. When Moses in his youth was the leader of the Egyptian army against the Aethiopians, and for the sake of peace had married an Aethiopian princess, on account of whom

Aaron and Miriam spoke against him, as recorded in the twelfth chapter of Numbers, being unwilling to dismiss her that he might return to Egypt owing to the depth of his love, he made, since he was a skillful astronomer, two images on rings, one of forgetfulness which he gave to the woman, and the other of memory which he kept for himself, and thus he freely departed from her with his army and without war. Josephus in the first book of the Antiquities states these facts, and the Master in the Histories and many others attest them. This was a wonderful thing that changed the heart of the woman. Solomon, moreover, made regulations respecting many things of this kind, which happened contrary to the ordinary course of nature, as Josephus states in the eighth book. Solomon, who was wiser than all who preceded him and all who followed, could not neglect these matters, and therefore left many things written in an enigmatical form, which later by the magi were turned to evil uses and were interpreted in the wrong way, in which have been mingled many hideous things by fraudulent people. But the wise know how to separate the grains from the chaff and the antidote from the serpent.

Aristotle, the greatest of the philosophers, shows how these works are performed in his book of Secrets, to the end that all wonderful things may be usefully promoted and all harmful things destroyed. For by these means Aristotle caused Alexander the Great with an army of less than 40,000 to conquer the world. When he lay on his death bed, and was already on the threshold of death, he rescued his city and country from enemies. The first of these facts is noted in the deeds of Alexander, and the second in Valerius Maximus, book V. But it is evident that he could not have done this by bodily power but by the great force of the wisdom which he has left in the books of the Secrets to be investigated only by the most wise. When owing to the burden of old age he handed the world over to Alexander after the defeat of Darius, he withdrew to his own land and bade Alexander write him on any matters he wished, and promised to give him fitting advice. When Alexander found tribes with very bad morals and wrote to Aristotle asking what he should do with them, that prince of philosophy replied, "If you can alter their atmosphere, allow them to live: if not, slay them all." Oh, how occult is the reply, yet how full

of the power of wisdom! For he understood that in accordance with a change of air, which contains the celestial forces, are the morals of men changed; for which reason the customs of Gauls, Romans, and Spaniards differ from one another, and the same is true concerning all other countries. Aristotle meant then that Alexander should change for the better the quality of the air of those tribes, so that in accordance with that change their morals might be changed and they might be influenced to adopt a high moral standard, without, however, losing freedom of will; just as each nation is influenced to adopt its moral standards by its own atmosphere, which contains the forces of the stars which are over the heads of the inhabitants, and in accordance with the signs or planets dominant over the particular regions. For I show in the treatise which I am sending that any one can be influenced to good and to evil, both public and private, by the forces of the heavens without constraint, just as by way of example we see that men change their desires through masters, friends, associates, occurrence of new conditions, and in countless ways without restraint. This matter I explain sufficiently in the chapter on the power of judging with regard to human affairs by means of the heavens, in which chapter there is an explanation of all matters relating to this subject. The philosopher wished then that he should perform deeds of wisdom by means of the necessary constellations in the manner of Moses, who stirred the mind of the woman by means of the celestial forces received in the material. For as that woman could be changed to purity and to a forgetfulness of her husband by means of images, so could she have been influenced also to adopt other morals, and not she only, but any other woman. Ptolemy in the ninth proposition of the Centilogium teaches that visages in this world are subject to the celestial visages. Hali says that Ptolemy in this chapter wishes to disclose the secrets of images. The purpose of these in general is obvious, since if one happens at chosen times to carve these images after the faces of the heavens, all harmful things can be repelled and useful things promoted. Thebit, the greatest philosopher among all Christians, who in many things has added to the works of Ptolemy and of other astronomers both in theory and practice, in particular has broadened this science,

and other very wise men were in the habit of stressing these matters.

But since these works seem to the rank and file of students to be beyond the human intellect, because the throng with its teachers has no leisure for the works of science, scarcely any one has ventured to speak about these works in public. For they are straightway called magicians, whereas they are the very wisest who know these things. Undoubtedly theologians and judges not instructed in such matters and seeing at the same time that evils as well as blessings can be produced in this way, neglect and abhor these things and reckon them as magic. They see also that magicians and those who abuse the teachings of science employ these means, and they therefore judge them unworthy of Christians. But truth must not be condemned as ignorance, nor utility as an evil, although they may become such; for in that case men should do without knives at table, since they are able to slay their table companions with the same piece of iron with which they are cutting their food, and weapons should be destroyed by the Church, and also the secular arm should be destroyed, because many evil things can be done by these means, and are accomplished daily. Good men must have recourse to the laws although many lawyers take advantage of the laws by means of sophistries and frauds. And now we see that students make more use of what has been written concerning sophistries than of the correct use of demonstrations. The study of science is not, however, on this account to be condemned. For things from which good men produce various blessings are always turned to evil by evil men.

Since, moreover, the rational soul has especial need of words formed efficaciously and by design, the astronomer is able to form words for chosen times which will have inexpressible power. For when the purpose, desire, and force of the rational soul, which is nobler than the stars, are in harmony with the force of the heavens, of necessity either a word or something else is produced of wonderful force in altering the things of this world, so that not only the things of nature, but human minds are drawn toward those things which the skillful adept wills, the freedom of the will remaining unimpaired, since the mind can follow the celestial forces fully without compulsion, as we showed and stated in the proper place.

From this source the use of characters and incantations began. For characters are like images, and incantations are words uttered in accordance with the intention of the rational soul, which receive in the mere act of pronouncing them the force of the heavens: whence I make mention in the third part of the wonderful potency of letters. For by this power our bodies are cured, venomous animals are driven off, all brutes are summoned to one's hand, likewise snakes from their caverns and fishes from the depths of the waters. For the matter of the world is changed to many wonderful forms, if those means are correctly employed, and therefore they can be wonderfully effective against malevolent men and against the enemies of the state, just like other actions due to stellar influence, as necessity requires. But accursed magicians have brought the greatest discredit on this branch of science, since not only in their evil practices have they abused characters and incantations written by the wise against harmful things and intended to be very great blessings, but they have added false incantations and worthless and fraudulent characters, by which men are seduced. Moreover, demons have tempted many, and both women and demons have taught many superstitious practices, with which the nation is filled. For old women of their own volition everywhere make characters, incantations, and enchantments, and the magicians use invocations of demons and conjurations of them and perform sacrifices to them. But all these things are accursed and outside of the paths of the philosophers, nay, opposed to their expressed opinions; and by these means the potency of philosophy is defamed. Therefore theologians of the present day and Gratian and the sacred writers have reprobated many useful and noble sciences along with magicians, not noting the difference between magic and true philosophy owing to the five reasons of which mention was made in Part One; a chapter necessary for every man aspiring to the great things of wisdom and desiring to separate the true from the false. For Gratian, even as he has written many laws which are now abrogated, a wiser opinion prevailing, so in speaking of the sciences has said many things which should be altered to another purport, as I shall explain more fully below.

I return, then, to the words and acts of the wise, formed by the force of the stars and the power of the rational soul; and

I shall give an explanation in summary regarding them in accordance with what the wise have taught. For just as a child born and exposed to a strange atmosphere, as it were to a new world, receives the impression of the celestial forces, from which he has a radical complexion which he can never lose, because what the new jar receives it retains the savor of when old; so is this true in regard to everything newly made, since it receives the force of the heavens at the beginning of its existence, and that force which it received at the beginning it never loses until it is deprived of its natural being and is corrupted. Therefore in these images, incantations, and characters, composed by means of the necessary constellation, the forces of the stars are received and retained, so that through them they can act on the things of this world, and when the constellation recedes in which the things of this kind were composed, they recede. And since the rational soul is nobler than the stars, therefore just as the stars and all things impress their forces and species on things external, species and forces of which I have written adequately in Part Four in discussing the potency of geometry, so then is the rational soul, which is the most active substance after God and the angels, able to impress and does continuously impress its species and force on the body, of which it is the moving impulse, and on the things external, and especially so when it acts with strong desire, definite purpose, and great confidence. Concerning these things Avicenna speaks ably in the sixth book of his Naturalia. Therefore things and words of this kind of which I am speaking receive not only a force from the heavens, but also from the rational soul, which is nobler, and for this reason they can have a great influence in altering the things of this world.

If it be said that just as things of this kind receive the force of the heavens, so do all other things which are in the same region, and existing at the time of the composition of words and things of this kind; and thus all things must possess these forces, men, cattle, horses, and trees, for the rays of the celestial constellations touch an infinite number of objects at the same time; we must reply that the objection has no weight, since the things are not in the same horizon; for all points on the earth's surface are the centers of different horizons, to which the vertices of different pyramids of the celestial forces come, so that

they are able to produce plants of different species on the same very small spot of the earth's surface, and to cause twins in the same womb to differ in complexion and habits, and in the use they make of the sciences and languages, in their occupations, and in all other things. Moreover, because other things were made earlier before the composition of the image, although they exist with it, yet they at their beginning received their own basic influence in accordance with which they act, and therefore the force of the heavens at this hour of which we are speaking does not have a natural effect on things of this kind, made previously, as it has in these things and words just now newly formed; and again since they were not formed by the rational soul, or at least not at that time; or if at that time, many other things are done by man, yet not with this purpose, nor desire, nor confidence, nor are they intended for actions of this kind, and therefore things of this kind will not have the power to alter, or at least not such noteworthy activities. If it be said that at all events everything will alter things external to itself and will sensibly change them, and especially so at its beginning by the force it receives at its beginning from the celestial constellation, since the basic complexion according to the force of the constellation remains in it; and that through the process of time, and through the other continuous forces of the heavens, the first force is lessened and weakened little by little, until it fails; we must reply that this is a fact; and in accordance with the origin of such things do great changes at times occur, although we do not consider whence such alterations happen, just as in the case of comets and some other things.

Again it is possible for us to bring out the true meaning of fascination, although it is a term under suspicion and can be understood in the way old women, fortune tellers, and magicians take it; yet it is certain that many men are of an evil complexion and of a corrupt and diseased nature, so that they are full of contagion like men diseased with many contagious sicknesses. Especially is there given to a nature of this kind an infected and contagious force by an evil constellation under which the child was conceived or born. For from the healthiest parents and possessed of the best complexion are born countless numbers who are of the very worst complexion; and these people, like all other things producing their own species

and force, contaminate things near them, especially things tender in age and complexion, and particularly have they this power through the eyes; since they are porous and not dense, and vapors and corrupt spirits come out of them and infect things. Hence Vergil says, "Some one or other is fascinating with his eyes my tender lambs." Just as a menstruous woman, if she look at a new and polished mirror, stains it with a bloody mist, as Aristotle says in his second book on Sleep and Waking, and experience teaches us, and thus she infects other things, although not so apparently, thus also lepers spread infection. All these things are in the course of nature. But if further some malign soul should think strongly on infecting some one else, and should ardently desire it, and definitely design it, and earnestly consider that he is able to harm, there is no doubt that nature will obey the thoughts of his mind, as Avicenna teaches in the eighth book on Animals and in the fourth on the Soul, so that there will be a more vigorous multiplication of species and a more violent infection; just as a leper, if he purposes and desires to harm some one whom he hates, and is full of confidence in his ability to do so, does that man far more harm than one against whom he plans no evil. For every action of a man is stronger and more impetuous when thought and will are directed to it, and with fixed purpose he forms his resolution, and firmly hopes that he can accomplish his purpose. For the wise say that as scammony sharpens a medicine and gives it vigor, so do intentions, desire, confidence, affect human actions; and still this is not magic.

For Pliny shows in the seventh book of the Natural History that many men are of such a complexion, who infect others and do harm from their presence, both by sight and by word. For since a word is generated from the natural members within and is formed with thought and care and a man delights in it, and it is the most ready instrument of the rational soul, therefore it has greater efficacy than any other thing man does, especially when it is uttered with definite intention, great desire, and strong confidence. A proof of this is found in the fact that nearly all the miracles performed by the saints from the beginning were effected by the force of words, whence there is a very great potency in words, just as I have explained. If the multiplication of species of this kind and the utterance

of the word take place under the necessary constellation, vigorous action must follow; and in all these things there is nothing magical or foolish. If this is called fascination, we can change the name if we wish. But with the wise such action is not subject to calumny. I have made mention of fascination; but it is explained here more fully. But since magicians and accursed old women do not view fascination in this way, but assert that sudden changes are brought about indifferently by any men whatever when the thing is seen early or late, or when they are talking about it, therefore the opinion of these people is worthless and reprobated by the wise.

I am writing these facts not only for scientific consideration, but because of the perils which happen and will happen to Christians and to the Church of God through unbelievers, and most of all through Antichrist, because he himself will employ the potency of science and will convert all things into evil. By means of words of this kind and by means of actions induced by the stars, and composed with a desire of doing harm and with a most definite intention and strong confidence, he himself will render unfortunate and will fascinate not only individuals, but also states and countries. By this wonderful method without war he will accomplish what he wishes, and men will obey him just as beasts, and he will cause kingdoms and states to fight against one another on his behalf, so that friends may destroy their friends, and thus he will accomplish his desires regarding the world.

Thus have the Tartars and Saracens been able to accomplish what they have done. For it is agreed that the Tartars give more time to astronomy than others, since although there are learned astronomers in many nations the rulers of their state are directed only by such advisers. Astronomers hold the same position among the Tartars as prelates do among us. Mangu Cham, emperor of the Tartars in the year of our Lord 1253, when the lord king of France, Louis, sent Friar William of the Franciscan Order to the Tartars, said to the Christians assembled before him including the friar mentioned, "We have a law from God interpreted by our diviners, and we do all things as they direct. You Christians have a law from God interpreted by prophets, but you do not follow it." This he said because in the East there are many evil Christians, like the

Nestorians and many others, who do not live according to the law of Christ. Friar William wrote to the lord king that if he had known a little about the stars, he would have been well received by them; but they despised him because he was ignorant of the terms of astronomy. The Tartars accordingly proceed in all things by means of astronomy, both in foreknowledge of the future and in the works of science. A proof of this is the fact that they have already subdued the whole world in its extent from north to east and from east to south, and now lack only two corners of the land of the Christians, namely, Egypt and Africa, although the Tartars are small, weak men, and hardly eat or drink anything to strengthen their nature, not swift of foot, and properly speaking unarmed except for arrows with which to frighten those whom they pursue, and although they never fight at close range in opposing lines of battle. For unless the Lord checked them and allowed frequent discords to be sown among them, they would have already seized upon the whole world. Hence their success must be due to the wonderful works of science by means of which they tread the world under foot. For the friar mentioned states in his book on the Manners of the Tartars which he sent to the lord king, that 14,000 Tartars defeated the sultan of Turkey, who had 200,000 horsemen without foot soldiers. But they could not have done this by force of arms, as is obvious, and hence they must have succeeded by means of science and especially by means of astronomy, by which they profess to be ruled and directed in all things. Similarly the Saracens make a great deal of use of astronomy and the wise among them know how to employ these means. It is greatly to be feared that the Tartars and the Saracens dwelling in their countries may send men to the Christians to bring misfortune on them by means of astronomy and to sow discords among Christian rulers, because the enemies of Christians strive especially to cause wars and discords among them.

For many things of this kind have been done although the foolish multitude does not consider their source. Perhaps you saw or heard for a certainty that the children of the kingdom of France once followed in countless numbers after an evil man, so that they could not be restrained by fathers, mothers, friends, and were placed on board of ships and sold to Sara-

cens. This event happened less than sixty-four years ago. Likewise in our times the shepherd leader stirred up all Germany and France, and drew to him a multitude of men, and had favor in the sight of the whole body of the laity in contempt of the clergy and to the confusion of the Church. He stated to Queen Blanche that he was going to her son beyond the sea, with such words deceiving a very wise woman. The wise should not doubt that they were emissaries of the Tartars and Saracens, and that they had some means by which they fascinated the people. I saw him with my own eyes carrying openly in his hand something as though it were a sacred object, and in the way a man would carry relics, and he went with bare feet, and was always surrounded by a host of armed men, yet so dispersed in the fields that he could be seen by all who met him, making an ostentatious display of that which he carried in his hand. Whatever the case may be regarding the Tartars and the Saracens, it is certain that Antichrist and his followers will employ these means. Moreover, unless the Church meets the situation by similar means which will hinder and destroy activities of this kind, she will be intolerably burdened by these scourges of Christian people. All wise men believe that we are not far removed from the times of Antichrist, as is obvious in the chapter on the sects viewed together in the light of astronomy. If then Christians knew that these means must be employed by papal authority to hinder the ills of Christianity, the result would be sufficiently laudable, and not only should such means be used to drive away evils, but also to promote blessings of all kinds. Since, moreover, individuals, states, and regions in accordance with what precedes can be changed for the better, life will be prolonged to a fitting length, and all things will be provided for in a useful way, and much greater things accomplished than should be entrusted to the present writing, not only in the things of nature, but in morals, sciences, and arts, as was revealed by Moses and Aristotle. These results are especially possible when the species and force of the rational soul of the worker, which is nobler than the heavens, is in accord with the force and species of the heavens, in such a way that there are present intense thought, ardent desire, definite purpose, full confidence, and especially sanctity of life; since nature obeys the thoughts and affections of the soul, and sanc-

tity especially. For in the eighth book on Animals Avicenna gives as an example the case of a vigorous hen which conquered a wretched cock, and in consequence of the glory of her victory a spur grew for her on the leg. Avicenna here remarks that in this instance we learn that nature obeys the thoughts of the sensitive soul. Also in the fourth book on the Soul he gives the example of a man who walking on a plank over water falls, because he is thinking of falling and loses confidence, and nature obeys the thoughts and affections of his mind. Hence he says that heat is not produced from heat nor cold from cold, but from the thought alone of the mind, and thus disease is caused and every change in the body belonging to it. Without doubt many effects can be produced in the body of another; since there is a certain kind of wolf that renders a man hoarse if it sees him first, as is commonly stated by authors. Much more vigorously can the rational soul, because of the nobility of its species, work many changes under the five conditions mentioned above, and especially when aided by sanctity, because sanctity is nobler than thought or desire, and for this reason the matter of the world is more obedient to the sanctified soul than to the other four conditions. We see this in full measure in the case of saints who have performed miracles, to whom the elements of the world were obedient. Avicenna in the fourth book on the Soul teaches that the soul sanctified and cleansed from sins is able to change the universe and the elements, so that by its virtue are produced rains, storms, and all changes in bodies in the world. It is, moreover, a fact that the grace of God does much, but the sanctified soul coöperates with grace, working the thing that is pleasing, so that a man is not saved by grace alone, but the soul must coöperate with such grace; much more vigorously then will it be able to cooperate with the grace given freely, which is the grace of miracles. But on other wonders it is better to ponder than to write, until by apostolic authority a greater attestation is required, and these things are possible. If you and the successors of your Holiness wish, it will be possible for all things to be completed. These are the basic principles in summary of the treatise which I proposed to write on such matters, but owing to obstacles I have been unable to write more.

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Bacon, Roger, 1214-1294
AUTHOR

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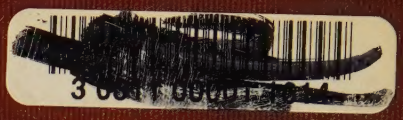
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